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*CHEMISTRY IN THE UNITED STATES.**

IN the history of science, from whatever point of view we may consider it, the several branches develop according to a natural order. The more obvious things attract attention first; the less obvious are recognized later. Plants, animals, stones and stars are studied even by savages; but the hidden forces of nature, governed by laws which can be utilized for man's benefit, escape discovery until civilization is far advanced, and even then are revealed but slowly. At first each department of knowledge is purely empirical, a mass of facts without philosophical connection; but sooner or later speculation begins, the scattered evidence is generalized, and an organized science is born. The study of concrete facts, the recognition of our surroundings, precedes the study of relations.

Among the sciences, chemistry is one of the youngest. As an organized branch of systematic knowledge it has little more than completed its first century. Before the time of Robert Boyle it was hardly better than empiricism. At first a few scattered facts were recognized, involving transformations of matter. Some of these were applied in the arts, as in metallurgy and in medicine; and their generalization led simply and naturally into alchemy, with its search for the philosopher's stone, the uni-

* Presidential address, Philosophical Society, Washington, December 12, 1896.

versal solvent and the elixir of life. There was no chemistry in the modern sense of the term, but only a group of visionary speculations which foredoomed their devotees to failure. In these failures, however, truth revealed herself, discoveries were made other than those which were expected, and the foundations of a new science were laid. It was more than forty years after the landing of the Pilgrims at Plymouth when Boyle announced the true definition of a chemical element, and the discovery of oxygen was not made until over a century later. The history of modern chemistry and the history of the United States begin at nearly the same time.

In America, as in the world at large, the development of science followed along the natural lines. A new country had no time for abstractions, such as chemical studies were in the early days, and only the more obvious branches of investigation received much notice. Botany and zoology flourished to some extent, and even mineralogy had able students; for the resources of an unexplored continent could not be ignored. Astronomy, too, was somewhat cultivated, but because of its usefulness in the measurement of time and navigation, rather than for its interest as an intellectual pursuit. The practical side of science was necessarily and properly foremost; and this fact is nowhere more apparent than in the physical researches of men like Franklin and Rumford. The obvious and useful came first; philosophy, theory, might wait until men had more leisure. So, while chemical discoveries were rapidly multiplied in Europe, little advancement could be recognized here. Even that little was utilitarian, and chemistry in this country was first brought into general notice through its relations to medicine and pharmacy, and through the agency of medical schools.

Prior to the year 1769 chemistry had no independent existence in the work of American colleges. It was taught, if indeed it was taught at all, only as a subordinate branch of natural philosophy. But in the year just named, Dr. Benjamin Rush was appointed to a chair of chemistry in the medical department of the University of Pennsylvania—an event which marks the first recognition of the science in the United States by any institution of learning. Other medical schools soon followed the example thus set, and chemistry took its place as a regular subject for study. Rush, however, was not specifically a chemist; he had, indeed, been a pupil of Black, in Edinburgh; but he carried out no chemical investigations and added nothing to the sum of chemical knowledge. His high reputation was won in other fields; but as the first professor of chemistry in America he occupies a historical position.

In 1795 the trustees of Nassau Hall, now Princeton University, elected Dr. John Maclean professor of chemistry. Other colleges soon followed the lead of Princeton, and within a very few years chemical science was well established as a distinct branch of study in many American institutions. The teaching, however, was wholly by text-books and lectures, the laboratory method was unknown, and the teacher commonly divided his attention between chemistry and other themes. There were professors of chemistry and natural philosophy, of chemistry and natural history, but rarely, if ever, professors of chemistry alone. Moreover, little time was given to the subject; the classics and mathematics overshadowed all other studies, and the pupil learned hardly more than a few scattered facts and the barest outline of chemical theory. When we note that to-day Harvard University employs twenty-two persons, professors, assistant professors, instructors and assistants in chemistry alone, we begin to realize the great advance which

has been made in the teaching of science since the days of Maclean, Hare and the elder Silliman.

In 1794 Joseph Priestley, the famous discoverer of oxygen, driven from his English home by religious persecution, sought refuge in America. He took up his abode at Northumberland, in Pennsylvania, where he died in 1804, and where his remains lie buried. His coming greatly stimulated the growing interest in chemistry upon this side of the Atlantic, for Priestley entered at once upon close relations with many American scholars, and took an active part in the work of the American Philosophical Society at Philadelphia. At Northumberland he completed his discovery of carbon monoxide, and made some of the earliest experiments upon gaseous diffusion; but unfortunately much of his time was devoted to theory, and to defending against the attacks of Lavoisier's followers, the moribund doctrine of phlogiston. Priestley's discovery of oxygen was the corner stone of chemical science; but the discoverer, great as an experimentalist, was not successful as a philosopher, and he never realized the logical consequences of his achievement. To the day of his death he opposed the new chemical philosophy and clung to the obsolete ideas of an earlier generation.

During the first quarter of the present century the progress of chemistry in the United States was slow. It is not my purpose to discuss in this address the details of its advancement, for that work has already been exhaustively done by another;* still several events happened which deserve notice here. First, Robert Hare, in 1802, invented the oxyhydrogen blowpipe. With that instrument, in following years, he succeeded in fusing platinum, silica and about thirty other refractory substances which had hitherto resisted all attempts at liquefaction. But few men have given a greater extension to our experimental resources. The calcium light and the metallurgy of platinum are among the direct consequences of Dr. Hare's invention. Secondly, in 1808 Professors Silliman and Kingsley, of Yale College, published their account of the meteorite which fell at Weston, Connecticut, the year previous. This paper attracted widespread attention, and drew from Thomas Jefferson the oft-quoted remark "that it was easier to believe that two Yankee professors could lie than to admit that stones could fall from heaven." The analysis of the meteorite was the work of Silliman, and was among the earliest of its kind. It was done with appliances such as a modern high school would despise, and without the aid of any manual of analytical chemistry; and its merit is due partly to the fact that it was well done, and partly to the way in which great difficulties were overcome. In weighing the work of the early investigators we must remember that they lacked the resources which are so easily commanded nowadays, and that the methods of research had not been reduced to system. Their success was in spite of disadvantages which would baffle most men; there was less encouragement than now in the way of popular applause, and their efforts are therefore all the more praiseworthy. To-day scientific investigation is an established art, its ways are well worn and well trodden; and, although the highest achievements are as difficult of attainment as ever, even a beginner may hope to accomplish something.

During these early years much attention was paid by American chemists to the study of minerals, for rich new fields were open; and in 1810 Archibald Bruce began the publication of *The American Mineralogical Journal*, of which four numbers were issued.

*Benjamin Sillman, Jr. 'American contributions to Chemistry.' American Chemist, August, September and December, 1874. An address at the 'Centennial of Chemistry.'

This was probably the first attempt to publish in this country a magazine devoted entirely to science and supported wholly by native contributions. As early as 1811 there was a Columbian Chemical Society in Philadelphia, and in 1813 a volume of its 'Memoirs' appeared. In 1817 the *Journal of the Academy of Natural Sciences of Philadelphia* was started; and the next year saw the birth of Silliman's *American Journal of Science*. The last named periodical, a classic among scientific serials, was for sixty years the chief organ of American chemistry; and even yet, despite the rivalry of more specialized journals, it contains a fair proportion of chemical contributions. The first American to publish a systematic treatise on chemistry was Prof. John Gorham, of Harvard College, whose 'Elements of Chemical Science,' in two octavo volumes, appeared in 1819. The work was well received and was an excellent one for its day.

The period from 1820 to the outbreak of the Civil War was one of steady progress in America, both as regards scientific research and in the development of institutions. Colleges were founded, societies were organized, there were better facilities for work, and the general appreciation of science became greater. But, for the reasons which were stated at the beginning of this address, the so-called natural sciences rather took the lead, and there was more activity among geologists and zoologists than in the field of chemistry. Many States organized surveys; the general government sent out exploring expeditions; and so geology and natural history received a patronage in which chemistry had little or no share. The chemists were mainly dependent upon their own resources, and got along as best they could. Still, their number increased, their published investigations became more numerous, and their services were in greater demand, both commercially and in the work of instruction.

At first the would-be chemist had to make his own pathway. Chemistry was taught in the colleges, not as a profession to be followed, but as a minor item in that ill-defined agglomeration of knowledge which in those days was called 'a liberal education.' In 1824, however, the Rensselaer Polytechnic Institute, at Troy, was founded, and a new era in scientific education began. In 1836 Dr. James C. Booth opened a laboratory in Philadelphia for instruction in practical and analytical chemistry, and in 1838 Prof. Charles T. Jackson did the same thing in Boston. Chemistry could now be studied in something like a systematic manner, but the students who were able to do so went abroad, at first to London, Edinburgh and Paris, and later to the famous laboratory of Liebig in Germany. The impulse toward foreign study continues to our own day; even though American facilities have increased enormously, and a good chemical training can now be obtained at home.

The decade from 1840 to 1850 was a period of great advancement in American Science, and several events of the utmost importance occurred. In 1829 James Smithson, an Englishmen, bequeathed his property to the United States, to found in Washington 'an institution for the increase and diffusion of knowledge among men;' and in 1846 his project was realized. The Smithsonian Institution was established, and under the direction of Joseph Henry it became at once a center of scientific influence and activity. Smithson, it will be remembered, was a chemist and mineralogist, and it was, therefore, eminently proper that the Institution which bore his name should, from the very beginning, maintain a chemical laboratory. Furthermore, in the earlier years of its history, the Institution provided courses of popular lectures upon chemistry; it has subsidized some chemical investigations, has published original researches,

and it has issued a number of useful works in the way of special reports, volumes of physical constants and bibliographies. Although its energies have been more conspicuously exerted in the fields of zoology, anthropology and meteorology, it has done much for chemical science; the subjects which interested its founder have never been neglected. In the history of American chemistry the Smithsonian Institution plays an honorable part.

In 1847 and 1848 the Sheffield and Lawrence Scientific Schools were founded, the one at New Haven, the other under the protecting shelter of Harvard College. In the one, chemistry was taught by J. P. Norton and the younger Silliman; while Horsford conducted the laboratory at Cambridge. The much older Polytechnic Institute at Troy had developed mainly as a school of engineering, so that the two new institutions practically stood by themselves, as the only higher schools of chemistry—schools in which professional chemists could receive a thorough training—within the limits of the United States. Their influence soon began to be felt, their graduates went forth to take important positions, the stimulus to scientific studies spread to the colleges, and the chemist became recognized as the representative of a new learned profession. Law, medicine and divinity no longer formed a class by themselves; other branches of scholarship were to take rank with them.

In 1846 Agassiz came to America, bringing with him the research method as a method of education. Himself a zoologist, his influence as a teacher was evident in all directions, and chemistry shared in the new impulse. There were many pupils of Liebig and Wöhler in the United States, men well imbued with the spirit of the new education; and to them the coming of Agassiz was a reinforcement and an inspiration. The old college curriculum was compelled to expand, and the true conception of a university began to be recognized on this side of the Atlantic. In 1848 the American Association for the Advancement of Science was organized, and science received a national standing which the local academies and societies could never have given it. The influence of the Association upon chemistry will be considered later.

In 1850 Josiah P. Cooke was elected professor of chemistry in Harvard College. He had received his bachelor's degree only two years earlier, but during his student days no chemistry had been taught to the Harvard undergraduates. Practically self-taught, and largely through the medium of experiments, he realized the value of the laboratory method of instruction and, in spite of conservative opposition, he set to work to bring about its adoption. He was allowed at first the use of one basement room for his purposes, but was compelled to pay all or nearly all of the laboratory expenses out of his own pocket, for the college funds could not be wasted on strange innovations, and the recitation method still reigned supreme. Prof. Cooke, however, understood how to be patient and persistent at the same time; year by year his courses of study were extended, by slow degrees his resources increased, and in 1858 Boyleton Hall, the present laboratory building, was completed. At first, part of the building only was assigned to chemistry; now all of it is devoted to the teaching of that science. It is truly a monument to Prof. Cooke, whose energy and persistence caused it to be erected, and to whom, more than to any other one man, the full recognition of the laboratory method in American colleges is due. The initiative was taken by the scientific schools, but the colleges were compelled to follow; and to-day even the high schools, the feeders of the colleges, have their chemical laboratories in which elementary practice and qualita-

tive analysis are taught. Chemistry is now seen to be one of the best disciplinary studies, and it fails in educational value only when the teaching of it is entrusted to improperly trained pedagogues of the obsolete text-book school. The teacher who is a slave of text-books is as bad as no teacher at all. To teach chemistry one must think chemistry; a mere memory for facts is not a sufficient qualification.

Leaving out of consideration the names of many American chemists who published important researches during this period of our history, for personal details would not be in place here, we come down to the date of the Civil War, which marks an epoch in more senses than one. In science, as well as in politics, the war divides American history into two periods—the one a period of preparation and slow growth, the other a period of swift advances and fruition. Through the war the Nation had received a sharp stimulus, and the re-establishment of peace was followed by wonderful progress in many directions. Population and wealth increased with great rapidity, and in due time that wealth began to flow into educational channels. The Nation itself embarked in many new enterprises; these demanded the aid of science, and so the latter received encouragement which its students had hardly dreamed of before. Even during the war the land-grant college bill was passed by Congress, and soon every State was provided with new facilities for scientific instruction, and the demand for trained teachers was greatly increased. The foundation of Cornell University, which opened its doors to students in 1868, was one of the consequences of this bill. In 1864 the School of Mines of Columbia College began its work; in 1865 the Massachusetts Institute of Technology was started; and these were followed by the Polytechnic School at Worcester in 1868, and the Stevens Institute at Hoboken in 1870. Even the older schools of science developed more rapidly, and in the Lawrence Scientific School particularly the research method of instruction was pushed into great prominence by Wolcott Gibbs. Hitherto our professors of chemistry had been commonly content with teaching what was already known, but under Gibbs the student was taught to think and to discover. Training in the art of solving unsolved problems became a part of the school curriculum. This phase of chemical education was brought into still greater prominence some years later, in the laboratory of the Johns Hopkins University, and now it is well nigh universal. Original research, once an occasional feature of American college work, is now emphasized in all of our better universities, and the student's thesis outweighs his examinations in importance. At first, as was but natural, our educational system was modeled after that of England, with Oxford and Cambridge as the shining examples to follow. Here, as there, the passing of examinations was the one supreme test of scholarship; but the growth of science in Germany attracted our better students thither, and they returned full of the modern doctrines. The German graft upon our English stock has made our universities what they are to-day, and now the man who can increase knowledge is more highly esteemed than him who merely knows. The knowledge which is fruitful outranks the sterile culture whose end is in itself. In all departments of learning, education has become more vital, more of a living force; and in this great movement forward the chemist has been a leader and a pioneer.

For many, many years the chemists of America were unorganized, a thousand scattered units, each doing what he could as an individual, but with no bond of union other than that of common interest. Here and there chemical societies were founded,

to last for a year or two and then perish for lack of proper support. They were local experiments, nothing more; and no list of them could be made. In the more general societies, like the American Academy in Boston and the Academy of Natural Sciences in Philadelphia, the chemists had a part, but it was one of minor importance—an item among many.

In the American Association for the Advancement of Science there were some chemists who attended the meetings from time to time, and occasionally presented papers. They were overshadowed, however, by the more active representatives of other sciences, and their share in the proceedings was rarely conspicuous. The Association was divided, at the time of which I speak, into two sections—A and B, and in the first of these chemistry, physics, mathematics and astronomy were crowded together, with chemistry the least prominent of all.

In 1873 the Association met at Portland; and a handful of chemists, most of them young and unknown, but enthusiastic, were present. The time was ripe for a step forward, and that step, a very short one, was taken. The Association was requested to allow the formation of a sub-section of chemistry; a year later, at Hartford, the request was granted, and the sub-section began its career.

Some two weeks before the meeting at Hartford, on August 1, 1874, about seventy-five chemists met at Northumberland, in Pennsylvania, to celebrate, at the grave of Priestley, the centennial of the discovery of oxygen. It was now proposed to organize an American Chemical Society, modelled after the already flourishing societies of London, Paris and Berlin; but action was deferred, in order that the new experiment in the American Association might have a fair trial, and that the danger of undue competition, with its attendant division of forces, might be avoided. The new sub-section received general support, it grew and flourished; and when, in 1881, the American Association was reorganized, it became the full Section C of the present body. To-day the chemical section is one of the strongest and most vigorous in the Association, with a large and faithful membership which has been built up in great measure by the efforts of the men who started it twenty-three years ago.

In 1876 the project for an American Chemical Society was revived, and an organization bearing that name was established in New York. It obtained a fair membership and published a journal; but as all the meetings were held in one city it did not command the support of the country at large, and it became essentially a local body in spite of its claims to national scope. It was national in theory, and also in purpose, but it failed to receive general recognition; and it exerted no wide-spread influence until, after sixteen years of existence, it became a potent factor in the development of a larger enterprise.

In 1884 the Chemical Society of Washinton was formed. This was professedly local in its character, and so too were several other bodies of chemists which were organized within a year or two of this time. There was no concentration of effort among the chemists of America, except in the American Association, and that, unfortunately, met but once a year. There were nuclei enough, however, for crystallization to begin, and in 1888 another step was taken. The chemical section of the American Association appointed a committee to confer with like committees from other societies, and to report upon the question of a national organization. Conference after conference was held; report after report was presented; there was opposition, of course, from various quarters, and indifference to be overcome; there were conflicts

of interest and the inevitable rivalries. But the movement was started; it was finally endorsed in due form by the old chemical section, and in time success was won. In 1891 and 1892 a plan was agreed upon, and the present American Chemical Society was established.

The two principal factors in the problem, apart from the American Association, were the American Chemical Society in New York and the Chemical Society of Washington. The former had the name and a charter, and, with some reason, claimed to occupy the field. The other made no claims, but would not concede primacy to the first. Professional interests and good feeling, however, carried the day; there were concessions from all sides, and the following plan was adopted: The existing name and charter were accepted. The New York body became a local section of the reorganized Society, and the Washington organization did the same. The old journal of the Society was consolidated with the flourishing *Journal of Analytical and Applied Chemistry*, with the editor of the latter, Prof. Hart, in charge. Other local sections were provided for, and it was agreed that the Society should hold two general meetings a year—one in winter, the other in coöperation with the American Association. Thus all interests were reconciled, and the scattered forces of the chemists began to converge toward a single point. A strong Society was created, with a good monthly journal; and to-day it numbers over a thousand members, with nine local sections in various parts of the country, carrying on continuous work. Hereafter the summer meeting will be held jointly with that of Section C in the American Association, making both bodies stronger and more efficient; all opposition has been overcome, the membership of the Society is rapidly growing, and the future seems bright. The example which has been set by the chemists may be a good one for others to follow. "In union there is strength." In New York there is also a section of the British 'Society for Chemical Industry;' and, in addition to the journal already mentioned, there is the well-established *American Chemical Journal*, managed by Prof. Remsen, at Baltimore, and a new periodical devoted to physical chemistry, which has just been started by Professors Trevor and Bancroft, at Cornell University. Our chemists are now well provided with means for publication, and there seems to be no dearth of material with which to fill the pages of the three separate journals. The *American Journal of Science*, the 'proceedings' of some local academies, and the foreign chemical periodicals also receive a share of our output. The facilities for publication seem to increase no faster than the activity of the American chemists.

On the purely scientific side the government of the United States has as yet done little for the advancement of chemical research. But indirectly, for economic reasons, it has done much, especially since 1876. So, too, have the governments of various States and cities, especially with regard to the analysis of fertilizers, and in the direction of sanitary chemistry. Some investigations concerning the water supply of cities have been carried out by local Boards of Health, and among these the researches instituted by the Massachusetts Board have been of the highest scientific quality. No better work of its kind has been done anywhere; and its results, intended for local benefit, are of far more than local value. On the part of the general government the patronage of chemistry has covered a wider range, and many bureaux have been provided with laboratories. In the Department of Agriculture a considerable force of chemists has long been employed, dealing with questions of the most varied character. The United States Geo-

logical Survey maintains another important laboratory, and still others are connected with the Bureau of Internal Revenue, the Mint, the Army and the Navy. In the Torpedo Station at Newport investigations are carried out relative to explosives, and at the custom house in New York a number of chemists are engaged in the valuation of imported articles with reference to the assessment of duties. In short, the government calls upon the chemist for aid in many directions, and the appreciation of his usefulness increases year by year. In all this work, however, chemistry is rated as a convenience only, and valued for what it can give; its advancement as a science is not considered, and such growth as it gains through governmental encouragement is purely incidental. Good researches of a strictly scientific character, real enlargements of scientific knowledge, have come from laboratories maintained by the government; but they represent the rare leisure of the investigator and not the essential object of his work. He is sometimes permitted to investigate for the sake of chemistry alone; but such labor is extra-official, and forms no part of his regular duties. The chemist is compelled to serve other interests, other sciences it may be; and only the time which they fail to demand is his own. Considering the enormous importance of chemical research to all the greater industries of the world, it should receive fuller recognition by the National government, and be encouraged most liberally.

I have already referred to the Land-grant College Act of 1862, under which so many agricultural and technical schools came into existence. In 1887 Congress passed another act, intimately related to the former, by which the States and Territories were each granted the annual sum of fifteen thousand dollars for the maintenance of agricultural experiment stations. These stations, some of which have other resources also, are actively at work, and they receive some coordination under a bureau of the Federal Department of Agriculture. Chemistry receives a part of their attention, and in 1894 one hundred and twenty-four chemists were employed in them. These chemists, and those connected with the Washington laboratory, are bound together in the Association of Official Agricultural Chemists, which meets annually. A prime object of that association is the improvement, definition and standardizing of analytical methods; and along this line it has done admirable work. The data obtained in the different experiment stations are thus rendered strictly comparable, and a higher degree of accuracy is reached than would have been attained under conditions of absolute individualism. The Association fills a distinct place of its own and is in no sense a rival of the American Chemical Society. Indeed, the members of the official body are nearly all members of the other.

In the industrial field, as well as in the domain of pure science, the chemists of the United States have made rapid advances during the past thirty years. In manufacturing chemistry the growth has been only moderate, at least in comparison with the growth of other industries, but still it is evident. We still import heavily, and depend upon Europe for many chemical products which ought to be manufactured here. In some special lines our goods are among the best; in others we are wofully backward. To some extent our tariff and revenue legislation has had a bad effect upon our chemical manufacturers; as, for example, in increasing the cost of alcohol; and certain defects in our methods of scientific teaching have also been to blame. To this subject I shall recur presently. In metallurgical processes the United States can hold its own, however, and especially in those which involve the applications of

electricity. The electrical furnace, for instance, as it is used in the manufacture of aluminum, is distinctly an American invention, and the electrolytic refining of copper is carried out in this country on a scale unknown elsewhere.

If we consider the subject of applied chemistry at all broadly, we shall at once see that it has several distinct aims; such as the discovery of new products, the improvement of processes and the utilization of waste materials. It seeks also to increase the accuracy of methods; to make industrial enterprises more precise, and therefore more certainly fruitful; in short, to replace empiricism by science. It is, perhaps, in this direction that chemistry has made its most notable advances in America, and that within comparatively recent years. Three decades ago, even our greatest manufacturing establishments employed chemists only in a sporadic fashion, sending occasional jobs to private laboratories, and then only after counting the cost most parsimoniously. Except in a few dyehouses and calico printeries, the chemist was not fully appreciated; great losses were often sustained for lack of the services which he could have rendered, and the cost of goods was therefore higher than was necessary. By degrees, however, a change was brought about; one effect of industrial competition was to narrow margins and to render greater accuracy of manipulation imperative; and so the chemist was brought upon the scene. To-day it is almost the universal custom among manufacturers to maintain chemical laboratories in connection with their works; and this is especially true with regard to metallurgical establishments, oil refineries, soap, candle and glass works, in the making of paints, varnishes and chemicals, and so on in many directions. Even the great firms whose industries are connected with the Chicago stockyards, with their artificial refrigeration and their manufacture of lard, lard and butter substitutes, meat extracts, pepsin and fertilizers, all employ skilled chemists and provide well-equipped laboratories. In the making of steel and iron the processes are followed by analyses from start to finish, from ore, fuel and flux to the completed billets; and the chemists who are thus occupied have gained marvellous dexterity. The analytical methods have been reduced to great precision, and are extraordinary as regards speed; work which once required a day to perform being now executed in less than twenty minutes. Exact measurement has replaced rule of thumb; certainty has supplanted probability; industry has become less wasteful and surer of a fair return; and to all this the chemist has been a chief contributor. Without his aid the manufactures of the world could never have been developed to their present magnitude and efficiency. His influence reaches even beyond the furnace or the factory and touches the greatest economic questions. Take, for example, the financial agitation through which our country has so recently passed, with its discussion of monetary ratios. Chemical processes have profoundly modified the metallurgy of gold and silver, cheapening the production of both metals, and changing the commercial ratio of their values. Can the bi-metallic question be intelligently investigated with the chemical factor left out? Furthermore, chemistry has created new industries in which both gold and silver are employed; and so, affecting both supply and demand, touches their ratios still more deeply. When politics becomes true to its definition, when it is really 'the science and art of government,' then we may expect politicians to consider questions like these and to study the evidence which chemistry has to offer.

One other phase of applied chemistry, chiefly developed in this country, remains to be mentioned. In 1875 the Pennsylvania Railroad opened a laboratory at Al-

toona, in charge of Dr. C. B. Dudley; and eight or nine other great railroads have since followed its lead. In these railroad laboratories, which employ many men, all sorts of supplies are tested, and large contracts for purchases depend upon the results of analysis. Among the articles regularly examined, preliminary to buying, are iron, steel, various alloys, paints, varnishes, soaps, wood preservatives, disinfectants, *et cetera*. On the Pennsylvania system alone the purchases controlled by these tests amount to from two to three millions of dollars annually, and the saving to the company is undoubtedly very great. In many cases other purchasers adopt the specifications of the railroad and base their contracts upon the same standards, the analyses to be made in the same way. Adulteration is thus discouraged and prevented, and the moral effect upon the seller, who must be honest, is most salutary. When detection is certain the temptation to commit fraud vanishes. To the improvement of analytical methods the railroad laboratories have contributed materially, so that their work has true scientific significance as well as practical value.

Now, although we may properly take pleasure in the advances which American chemists have made, we have no right as yet to be fully satisfied. We have done much, but others have done more; and until we stand in the front rank we should not slacken our efforts. The competition of research is fully as keen as the competition of trade, and even if we may win the lead we must work hard to keep it. In spite of all that I have said of its growth, industrial chemistry in the United States is still in its infancy, and comparison with other countries is in some respects wholesomely humiliating. England and France have built up chemical industries vastly greater than ours, and in certain directions Germany leads them both. Moreover, the German industries and the trade depending upon them are increasing at a marvelous rate, and in England the chemists at least have taken serious alarm at the growing competition. Branches of manufacturing which were once almost wholly English are now mainly German; discoveries which were made in England have been developed in Germany, and now the British economists are seeking for the reason.

To the chemist the reason is plain, and is to be found by a study of two systems of education. The English universities and schools have clung to obsolete methods, and have attached great importance to examinations and the winning of honors. To the honor men positions and preferment are open, but the honors are awarded in the wrong way. In Germany, on the other hand, the pathway to success lies through research; honors are given to the men who have increased knowledge; and the effect of this policy is felt by every manufacturer upon German soil. Take, for example, the great chemical works at Elberfeld, in which about one hundred scientific chemists are employed in addition to a great force of laborers. Every one of these chemists received a training in research; every one is expected to make discoveries; and the results of their investigations are immediately applied in the manufacture of new preparations and the improvement of processes. The German employer does not ask the chemist to do for him what he can do already, but rather to supply the greater forces by which he can rise above his competitors and command the custom of the world. To that policy we have not yet fully risen in America; our technical schools have thought too much of routine drill and discipline; and until we profit by the example of Germany more thoroughly than we have done we cannot hope to rival her in chemical industries. Our practical men value science for what it can do directly

in their interest, and rarely look deeper into the possibilities of abstract investigation. In reality, pure science and applied science are one at the root; the first renders the second possible, and the latter furnishes incentives for the first. Where science is most encouraged for its own sake there its applications are most speedily realized. This is a lesson which America has yet to learn, at least to the point of full and complete appreciation.

What, now, have we done, and what should we do? We have made a great beginning; we have built up good laboratories, backed by richly endowed institutions of learning; millions of dollars have gone into the teaching of chemistry, and the stream of research flows on with ever-increasing volume. American investigations and investigators are known throughout the civilized world; their creditable standing is fully recognized; our analysts are among the best; and yet—and yet—something is wanting. A great mass of good work has been done, beyond question; but no epoch-making generalization, fundamental to chemistry, has originated in the United States, nor has any brilliant discovery of the first magnitude been made here. The researches of American chemists have been of high quality, but not yet of the highest; there is solidity, thoroughness, originality; but with all that we cannot be satisfied. The field is not exhausted; there are great laws and principles still to be discovered; the statical conceptions of to-day are to be merged in wider dynamical theories; for every student there are opportunities now waiting. Shall we do our share of the great work of the future, or shall it be left to others? Shall we follow as gleaners or lead as pioneers? He who has faith in his own country can answer these questions only in one way.

At present, American chemists labor under some disadvantages which have not been fully out-grown. Research, with most of them, is at best encouraged, but not expected as an important professional duty. The teacher must first teach, and in too many cases the routine of instruction takes all his strength and time. The resources available for education have been scattered by sectarian rivalry; several schools are planted where only one is necessary; and the teachers, duplicating one another's work, and furnished with slender means, cannot specialize. Two chemists dividing the work of one institution can do more than four who labor separately. The field is too large for one man to cover alone, and yet most of our men are expected to do it. This evil, however, is growing less and less, and in time it may cease to operate. With the increase of true post-graduate institutions the work of American chemists will improve, for in that part of the educational domain research is an essential feature. Give our men the best opportunities, the best environment, and they will do their share of the best work.

In one direction, perhaps, the possibility of advancement is greatest, and that is in the institution of laboratories for research. At present the labor of investigation is unorganized, unsystematic, a little here, a little there, but no coördination; and consequently our knowledge is after all a thing of shreds and patches. In making this statement I do not exaggerate. Take any class of scientific data, examine any series of chemical compounds, and note the gaps which exist in it. A chemist in Berlin has studied one of the compounds, another in Paris has prepared a second, many bits of information have been gathered by many individuals, and so knowledge slowly accumulates. The organization of research is to be one of the great works of the future, when discovery shall become a profession, and groups of students shall cooperate to-

ward the attainment of clearly specified ends. To some extent this work has already been done for astronomy, and more than one observatory could exemplify what I mean. In a fully manned and equipped observatory great investigations, too large for one astronomer to handle alone, can be carried out systematically; and this is actually done. In mapping the heavens, even, several observatories can combine their forces, each one covering a definite part of the field; but in chemistry no policy of this kind has yet been possible. The extension of the observatory method to other departments of science is the advance for which I plead.

Suppose now we had a great laboratory, fitted up for chemical and physical work together, well endowed and well manned. What might we not expect from it? Great problems could be taken up in the most thorough and orderly fashion, methods of work might be standardized and groups of physical constants determined; the results would aid and stimulate individual students everywhere, and applied science, too, would receive its share of the benefit. There is to-day a growing commercial demand for accurately determined constants, and no institution in which the demand may be adequately supplied. At Charlottenburg, in Germany, there is a beginning; in London the munificence of Ludwig Mond has made possible a similar start; but nowhere is such a plan as I propose in full and perfect operation. The United States has great observatories, fine museums of natural history and flourishing universities; why should it not have institutions for physics and chemistry also? These sciences touch many industries at many points; their applications have created wealth beyond all possibility of computation; now let that wealth do something for them in return. Half the sum that the Nation spends in building one battleship would erect, equip and endow a laboratory more complete than any now existing, whose influence would be felt throughout all civilized lands and endure as long as humanity. In this the United States might take the lead and set a great example to all other nations. The United States has long been a follower in science; may she soon take a higher place as teacher.

F. W. CLARKE.

U. S. GEOLOGICAL SURVEY.

THE AMERICAN PHYSIOLOGICAL SOCIETY.

THE ninth annual meeting of the American Physiological Society was held in Boston and Cambridge on December 29 and 30, 1896. The sessions of the first day were held at the Harvard Medical School, those of the second day at the University Museum, Cambridge. The following communications were presented and discussed:

Studies in the physiology of the mammalian heart. W. T. PORTER.

Cannulas were placed in the aorta and the innominate and pulmonary arteries of the cat. A thermometer was inserted in the right auricle through the superior vena cava. All other heart vessels were ligated, except the coronary arteries. Warm defibrinated cat's blood flowed into the aorta under pressure, passed through the coronary vessels and escaped, in drops as a rule, from the pulmonary cannula. A mercury manometer connecting with the innominate artery recorded the pressure at the mouths of the the coronary arteries. A Hürthle membrane manometer, coupled with a tube that was passed into the left ventricle through the left auricular appendix, registered the force and frequency of ventricular contraction. Variations in the temperature of the blood and the volume of the escaping drops were too slight to affect the correctness of the conclusions.

Intraventricular pressure curves were presented to demonstrate the following

facts: A fall in the volume of the coronary circulation, *e. g.*, 73 %, caused a fall in the force of the heart beat of 49 %, while the frequency was altered but 9 %. Restoring the volume of the coronary circulation restores the force and frequency of the heart beat. The change in force follows the change in blood supply immediately. These and other related observations are about to be published in the *Journal of Experimental Medicine*, by J. B. Magrath and H. Kennedy.

Miss Hyde has studied by the same method the effect of distention of the heart on the volume of the coronary circulation. Distension of the left ventricle, *i. e.*, making a constant pressure in the ventricle through a side branch of the membrane manometer tube, diminishes *per se* the volume of the coronary circulation. Distention acts further as a stimulus to the cardiac muscle, causing the ventricle to beat more strongly. Strong contractions of the ventricle cause an increase in the volume of the coronary circulation. If the ventricle, having been distended, is placed again at atmospheric pressure, the force of contraction is much diminished.

Dr. Porter also showed curves recording the diminution in coronary flow occasioned by stimulation of the peripheral end of the vagus nerve. Increase in coronary circulation follows stimulation of the cervical sympathetic. These results indicate vasoconstrictor fibres in the vagus and vasodilator fibres in the sympathetic.

Later Dr. Porter demonstrated his method of isolating the cat's heart for purposes of physiological investigation.

On the duration of cardiac standstill with different strengths of vagus stimulation. T. Hough.

A stimulus of uniform strength was obtained by the use of a storage battery in the primary circuit, which was interrupted by the revolutions of a small electric motor run at a constant rate of speed; the strength of stimulus was varied by changing the resistance in a German silver rheochord placed in the primary circuit. It was found that when the inhibitory impulses, obtained by stimulation of the vagus nerve, are just strong enough to bring the heart of the dog to rest, the duration of standstill is not so long as with stronger stimuli; but that a very slight increase of stimulus above this point produces a stand-still which is not lengthened by any further strengthening of the inhibitory impulses. The conclusions drawn from previous work on the same subject (Journal of Physiology, XVIII., 190) are, therefore, correct.

Some experiments on the relation of the inhibitory to the accelerator nerves of the heart. R. Hunt.

Some of the effects of stimulating the two nerves separately were first described; then the result of stimulating the nerves simultaneously. The experiments show that, contrary to the commonly accepted opinion of Baxt, the inhibitory and accelerator nerves are to be regarded as purely antagonistic; that the result of stimulating the two together is approximately the algebraic sum of the effects produced by stimulating them separately. In no case did one nerve completely overcome the effect of the other, though the two were stimulated for periods as long as twelve minutes. The experiments were performed upon dogs and cats.

Exhibition of plethysmographic curves obtained during sleep, with remarks. W. H. Howell.

Prof. Howell exhibited plethysmographic curves showing the changes in volume of the hand and wrist during the period of normal sleep. The apparatus was so arranged as to register the actual changes in volume without altering the pressure upon the parts under observation. The curves showed that from the beginning of the at-

tempt to go to sleep a gradual increase in volume took place, the unconsciousness of sleep appearing at some point during this increase. The volume reached its maximum within one or two hours after the beginning of sleep, and then for an hour or two remained practically constant. Following upon this there appeared a gradual constriction, which at first was very gradual, but increased more rapidly during the last half or three-quarters of an hour of sleep, and brought the volume curve at the time of awakening nearly or quite to the point shown at the beginning of sleep. The curves exhibited also throughout the sleeping period long periodic waves of constriction and expansion, lasting for an hour or more, and numerous shorter rapid constrictions and expansions, which were connected with the movements of the sleeping subject or with external stimuli such as noises in the street.

Upon the assumption that the increased volume was owing to a vascular dilatation, particularly in the skin, the author pointed out that upon the accepted view of the regulation of blood supply in the brain, the volume of circulation and the pressure within this organ during sleep must stand in reciprocal relations to the volume changes exhibited by the limbs, that is, during the period of sleep the blood supply to the brain and intracerebral pressure gradually diminish to a minimum which is reached within the first one or two hours; this condition remains practically constant for the following hour or two, and is then succeeded by a gradual increase in blood flow and intracerebral pressure, which may be said to reach the normal condition at the time of awakening. The author explained the vascular changes by a fatigue and subsequent resumption of tone in the vaso-motor center, especially in that part controlling the skin circulation. He pointed out the want of parallelism between the curves of intensity of sleep and the curves showing the vascular changes, and developed a theory of sleep which referred the immediate cause of sleep and of spontaneous awakening to the conditions of blood supply and pressure in the brain, which are indirectly controlled by the state of the vaso-motor center.

The relation between height, weight and age in growing children. H. P. BOWDITCH.

Prof. Bowditch showed curves derived from his own observations on Boston school children, and those of Dr. Porter on St. Louis children, showing that the relation between height and weight varies with the age in such a way that older children are heavier in proportion to their height than younger children.

On the contraction of the stomach produced by direct stimulation and by stimulation of the vagi with the faradic current. S. J. MELTZER.

1. Bipolar faradic stimulation with a current strong enough to produce a maximal contraction when applied to the serosa usually fails to produce any local or peristaltic contraction of the muscularis of the stomach, when applied to the mucous membrane of any part of the stomach. 2. When the faradic stimulus is applied to the serosa the effect varies according to the part of the stomach which is stimulated. As regards contractility, the stomach possesses a negative and a positive pole; the extreme end of the fundus does not even with very strong stimuli contract, while the pyloric end responds to a moderate stimulus with a strong contraction. The parts lying between the poles show a gradual transition from one extreme into the other; the further from the left end of the stomach, the walls contract more readily and more strongly. 3. Stimulation of the pneumogastric nerves causes a distinct contraction, which is strongest after the cessation of the stimulation. This contraction is also

mainly limited to the right part of the stomach.

Later Dr. Meltzer demonstrated the above stated results on the stomach of a well anæsthetized dog.

An experimental investigation of some of the conditions influencing the secretion and composition of bile. (With Mr. A. Balch.) Fr. Pfaff.

The subject of the investigation was a female patient of the Massachusetts General Hospital. Dr. H. H. A. Beach had operated on the patient for distention of the gall bladder. As a result of the operation a fistula remained, through which all the bile secreted was discharged. The jaundice, which existed before, disappeared completely in the course of a few weeks, the urine becoming bile free. The fæces remained completely clay-colored. At the time the investigation was begun by Dr. Pfaff and Mr. A. Balch, a student in the Harvard Medical School, the patient felt perfectly well. The bile escaping through the fistulous opening was collected in graduated jars, measured and analyzed every six hours. The specific gravity, the total amount of solids, and the ash of each sample of bile were determined.

The influence of human bile, ox bile, salol, sublimate, calomel and a mixture of pure bile salts on the daily excretion and the composition of the bile was studied. Human bile, ox bile and the mixture of the pure bile salts, dried and made into pills, increased the daily secretion and the amount of solids. Salol had scarcely any effect. Sublimate and calomel, if anything, slightly decreased the daily secretion. During the time of observation, ninety-seven days, the patient remained perfectly well, and has increased in weight from 113½ to 127 pounds.

The production of sugar from gelatine in metabolism. G. Lusk.

Experiments described at the last meeting showed that subcutaneous injection of phlorhizin every eight hours into starving rabbits produced, after the first day, the removal of dextrose through the urine in a constant ratio to the nitrogen eliminated at the same time. The ratio may be represented thus: D : N :: 2.8 : 1. This condition the author terms 'total phlorhizin diabetes,' since the ratio is the same as obtained by Minkowski after the extirpation of the pancreas in dogs, in 'total pancreas diabetes.' If rabbits with total phlorhizin diabetes be fed with 5 grams of gelatine, there is a simultaneous rise in both sugar and nitrogen in the urine of the corresponding day, showing respectively the absorption of the gelatine and the production of sugar from it. The proportion between dextrose and nitrogen is represented in one case by 2.5 : 1. Further experiments upon dogs, to whom gelatine is obviously a more natural food than to rabbits, are in progress in the author's laboratory. According to Külz 'phloridzin' and 'phlorizin' are false orthography.

Demonstration of a convenient form of apparatus to avoid explosions in gas analysis. G. T. Kemp.

The apparatus is a new and simple form of grisoumeter for use with mercury. The gas mixture, instead of being exploded by the electric spark, is subjected to the action of a platinum spiral heated white hot by an electric current. This causes the complete combustion of gases in non-explosive proportions, obviates the addition of explosive mixtures, and allows the gases that are to be analyzed, when present in small amount, to be diluted with a neutral gas to a volume convenient for handling in the different steps of the analysis.

The structure of the sympathetic ganglia of vertebrates, with demonstration of preparations. G. C. Huber.

Sympathetic ganglia taken from various

fishes, amphibians, reptiles, birds and mammals were studied by means of methylene blue and alum carmine as in the subsequent paper. The cells of the sympathetic system are multipolar, except in the amphibians, where large unipolar cells are found. The multipolar neurons have several protoplasmic branches (dendrites) and one axis cylinder (neuraxis); the unipolar cells have the neuraxis only. The cell body of the neurons is enclosed within a nucleated capsule. The dendrites break up into a system of finer branches which terminate between the ganglion cells; the plexus is extracapsular. Large medullated fibres and sympathetic fibres end in the ganglion.

The large medullated fibres branch repeatedly in the ganglion, ultimately terminating in pericellular end-baskets, which enclose the bodies of the sympathetic cells. These end-baskets are always intracapsular, and show different degrees of complexity in the various classes of vertebrates. In fishes they may be either very simple, composed only of a few fibrillæ, or very complex; in the latter case some of the fibrils of the end-basket enclose the cell body of the neuron in question, while others seem to end between small cells, the nature of which has not yet been determined, but which are also within the capsule of the cell. In amphibians the medullated fibres are twisted spirally about the axis cylinders of the unipolar cells here found, before terminating in the end-baskets enclosing the bodies of the cells. In reptiles the appearances vary greatly in different ganglia and in different parts of the same ganglion. Here, also, very simple end-baskets may be found; again the medullated fibre may make one, two, three or four turns around the axis cylinder of a sympathetic cell before breaking up into the finer branches of its end-basket, and finally very complicated endings may be observed, where one or several medullated fibres are wound separately around the axis cylinder and the adjacent portion of a sympathetic neuron before terminating in a very complex intracapsular end-basket. In birds and mammals the medullated fibres terminate in end-baskets which, as a rule, are rather simple, being composed of terminal fibrillæ, more or less loosely interwoven and always found between the body of a sympathetic ganglion cell and its capsule.

Sympathetic nerves ending in a ganglion break up into fine branches, which would seem to terminate in free endings on the protoplasmic branches of the sympathetic cells of the ganglion without forming end-baskets.

This conclusion has been drawn: The large medullated fibres ending in pericellular baskets come from the cerebro-spinal system and place the sympathetic ganglia in connection with the brain and cord, while the sympathetic fibres with free endings come from other sympathetic ganglia.

Remarks on the ending of nerves in muscle tissue, with demonstrations. G. C. HUBER.

The methods used in preparing the sections was the following: A 2 per cent. solution of methylene blue in normal salt solution was injected into a vein. Some time after the injection the tissues were exposed and developed in the air. As soon as the motor endings were recognized in the fresh muscle, the tissues were fixed in ammonium molybdate (Bethe), dehydrated in alcohol, embedded in paraffine, and sectioned. The sections were then fixed to a slide, stained in alum carmine and mounted in balsam. In order to determine with some degree of certainty the relation of the end-organs to the muscle fibres, the latter were cut in both horizontal and cross-sections. The conclusions are as follows:

A. Voluntary muscle (rabbit). The granular sole is an accumulation of sarcoplasma at the point of entrance of the nerve;

the nuclei of the sole are nuclei of the sarcoplasma. The axis cylinder of the motor nerve ends in an end-brush in the sarcoplasma. The neurilemma becomes continuous with the sarcoplasma.

B. Heart muscle (cat and dog). Axis cylinders of sympathetic ganglion cells terminate *on* the heart muscle cells either as very simple endings, namely, one or two very fine end-branches which terminate in small granules or bulbs, or in somewhat more complicated end-organs composed of several small twigs, these usually ending also in the bulbous enlargement.

C. Involuntary muscle (cat, rabbit and tortoise). The ending here is very simple. The terminal branches of the axis cylinders course along between the involuntary muscle cells, giving off in their course very fine side branches which end on the cells often near the nucleus.

The functional development of the cerebral cortex in different groups of animals. W. Mills.

The dog, cat, rabbit, guinea pig, rat and mouse were studied. Only those animals were used whose exact age was known, and ether was the anæsthetic invariably employed. The research was carried on in connection with investigations on the psychic development of the same animals. The following are among the most important conclusions drawn:

In the dog, cat, rabbit (and, in so far as the author's experiments go, in the rat and mouse) neither the brain cortex nor the underlying white matter is excitable by electrical stimulation at birth or for some days afterwards. The cortex is usually not excitable till about the period when the eyes open, though there are exceptions to this rule, most frequently in the author's experience in the cat, in favor of an earlier date. The white matter of the brain just beneath the cortex is generally excitable either at an earlier date than the cortex or with a weaker stimulus. The reaction for the limb movements is obtainable invariably somewhat earlier in the dog and the cat, and generally so in the rabbit, than those for the neck, face, etc. Localization for the cortex, and still more for the white matter, is at first ill defined, but gradually, though rapidly, becomes more definite. In the cavy (guinea pig) the cortex and the white matter beneath are electrically excitable either at birth or a few hours afterwards, and perfection of reaction and localization is reached in a few days. Before the brain cortex responds to electrical excitation, ablation of the motor area (centers) leads to no appreciable interference with movements. The younger the animal, the stronger the current required to produce reaction up to the time that localization is well established, *i. e.*, the weakness of the current required to cause a movement is an indication of the degree of development of the center in question. Differences for breeds and individuals exist and constitute to some extent exceptions to the above general statements.

In the above, 'cortex' refers to the gray matter in or near the motor area, and 'white matter' to the brain substance immediately beneath.

The restoration of coordinate power after nerve crossing. R. H. Cunningham.

Read by title.

The proteolytic action of papain. R. H. Chittenden.

The exact relationship of the vegetable proteolytic enzymes to the corresponding enzymes of animal origin has never been quite clear. The conditions governing the action of both papain and bromelin indicate a closer relationship to trypsin than to pepsin. The products found, however, appear to differ somewhat both chemically and physiologically from the corresponding products formed by animal enzymes. Brom-

elin, the ferment of pineapple juice, like trypsin, is unquestionably a typical peptone-forming enzyme. Quite recently, however, a number of investigators have stated that papain is unable to form peptone, *i. e.*, that its digestive action is limited to the formation of proteoses. The present experiments made mainly by Mr. McDermott, on the other hand, clearly show that papain is able to form true peptone quite readily from coagulated egg albumin, from blood fibrin and from the coagulated proteids of muscular tissue. This peptone-forming power is manifested in a few hours at 40° C., and in the presence of one per cent. sodium fluoride, thymol or chloroform water.

Experiments on the physiological influence of alcohol. C. F. HODGE.

The experiments reported have been conducted during the past three years for the Committee of Fifty, the purpose being to collect impartial data in the general physiology of the subject. Attention has been directed chiefly along three lines, namely, the influence of alcohol: 1st, upon growth, including reproduction; 2d, upon psychic development; 3d, upon animal activity and ability.

Experiments, already reported, upon the growth of yeast proved that in fresh cultures an addition of $\frac{1}{1000}$ of one per cent. of pure alcohol retarded growth materially proportionately much more than larger amounts.

Experiments upon kittens and puppies were made as follows: Two pairs of kittens as much alike as possible, the males from one litter, the females from another, were selected. Alcohol in moderate doses was given to one pair, the other pair being kept on normal diet for comparison. At the end of ten days' administration of alcohol the alcoholic pair had contracted severe colds, and alcohol was discontinued until recovery should take place. This, however, did not occur, so that the administration of alcohol was permanently discontinued. Curves of weight showed that the alcoholic pair had been dwarfed, the male and female attaining only 39 % and 63 % respectively of the weight of their controls. From later developments in the course of the experiment, it is probable that this stunting effect is to be ascribed chiefly to the disease rather than to the alcohol. The alcoholic kittens became very quiet, various psychic characteristics, notably playfulness, purring, fear of dogs and game instincts, dropping out with great abruptness. Disease becoming thus intercurrent, however, renders any definite interpretation of the experiment impossible.

Similarly two pairs of cocker spaniel puppies were carefully selected, the males brothers, the females sisters. Great care was taken to avoid pathological complications and to keep the experiment as strictly as possible on physiological lines. Accordingly non-intoxicant doses were used and were increased as the puppies grew. These now amount to 35 and 38 cc. of absolute alcohol for the female and male respectively; that is, about 4 cc. per kilo of body weight has been given daily since the puppies were nine weeks old. Growth has been practically normal, the alcoholic pair even growing a little faster than their controls at first. Possibly four dogs could hardly be found to grow more uniformly under normal treatment. Each normal animal is, however, about 5 % heavier than its alcoholic brother or sister. On the side of the reproductive functions, too, the puppies of the alcoholic pair are not inferior to those of the normals.

The chief difference is on the psychic side. Both the alcoholic animals are much quieter than their controls and both are abnormally timid. As tested by the pedometer method the alcoholic male was found to develop 71 % of the daily activity of his brother, the female only 57 % of her sister. Much severer

tests of ability were made by throwing a ball, the dogs competing on equal terms for its possession and for the privilege of bringing it back. In two series of tests made in this way, 1,400 and 1,000 balls being shown, the alcoholic male has shown an efficiency of only 32% and 44% as compared with that of his brother. On account of differences in condition, no satisfactory test has been possible as yet with the females.

A series of photographs taken at intervals during the research was exhibited.

The physiological action of nitrous oxide. G. T. Kemp.

It has been claimed that the supposed anæsthetic properties of nitrous oxide are due to its asphyxiating power. A careful comparison of its physiological action with that of a neutral gas, such as nitrogen, shows that in nitrous oxide separate anæsthetizing and asphyxiating powers may be demonstrated. To supplement this, a series of analyses of the blood gases of animals asphyxiated by nitrous oxide shows that anæsthesia may be obtained with this gas while the blood is still carrying sufficient oxygen to meet the demands of the system. Work with nitrous oxide and oxygen indicates that soon an anæsthetic may be recommended, which will be effective and yet avoid the objections applying to chloroform and ether.

On bactericidal effects of lymph from the thoracic duct. (With Dr. Charles Norris.) S. J. Meltzer.

In contrast to the surprising statements of Max Neisser that the lymph coming from the thoracic duct does not contain bactericidal properties, the authors find the lymph coming from the thoracic duct of dogs to be distinctly germicidal for the typhoid bacillus. The bactericidal power of the lymph differs from that of the blood in not becoming exhausted even after days. Neisser apparently employed unreliable methods.

On the interpretation of the so-called latent period of the motor nerve-endings, and on the supposed demonstration of their exhaustibility. F. S. Locke.

The replacement by mere contact of the continuity formerly believed generally to exist between irritable structures would seem to necessitate more attention being given to the 'discharge hypothesis,' on which Kühne has especially insisted—namely, that the motor nerve-fibre stimulates the muscle-fibre by means of its action current, which acts as an electric stimulus. The author's experimental results favor the view that the so-called latent period of the motor nerve-endings, which has been held by Bernstein and others to be crucial against the hypothesis, may be due to the nature of the electric stimulation by the action current. It was found that the secondary stimulation of one frog's sartorius muscle by the action current of another is associated with a measurably longer latent period than is stimulation with an induction shock.

Another argument against the 'discharge hypothesis' might conceivably be founded on the supposed exhaustibility of the motor nerve-endings. It was found, however, that if the curarised sartorius be continuously tetanised by make and break shocks through one pair of electrodes, till 'exhaustion' is complete or nearly so, then sending the tetanising shocks through another pair of electrodes situated on different points of the muscles gives again good tetanus. 'Exhaustion' in consequence of electric tetanisation is, therefore, primarily polar, and the results that have been supposed to demonstrate the exhaustibility of motor nerve-endings are readily reconcilable with the 'discharge hypothesis,' local 'exhaustion' of the muscle substance immediately in

contact with the nerve-endings replacing fatigue of these themselves.

The 'discharge hypothesis' affords a new conception of the real nature of inhibition and accounts for the actual properties of inhibited muscle. The anelectrotonus of the muscle substance, which must necessarily accompany the more active katelectrotonus even in the case of the action current of the motor nerve-ending, may not inconceivably become by greater anodic current density the more active in the case of the action current of inhibitory nerve-endings, and be the essential factor in the production of inhibition.

Gum arabic and the frog's heart. F. S. LOCKE.

The author has again found, in contradiction to M. Albanese's recent statement, that sodium arabate, unlike gum arabic (from which it differs by containing sodium in place of calcium, magnesium and potassium), confers no special sustaining power on 6 per cent. sodium chloride solution, weakly alkalinized with sodium carbonate and saturated with oxygen.

The measurement of the output of the heart. G. N. STEWART.

A solution of a substance (*e. g.*, sodium chloride), which can be easily recognized and quantitatively estimated in the blood, is allowed to flow at a known rate for a measured time through the external jugular vein into the heart. When the mixture of blood and injection liquid has reached a convenient point of the arterial system beyond the heart, *e. g.*, the femoral artery, a sample is drawn off during its passage. From the composition of this sample, the amount of blood with which the injection liquid must have been mixed in the heart, that is, the outflow (or inflow) of the heart during the time of injection, is determined. The electrical resistance of the mixed fluid being different from that of the blood, a telephone is employed to announce the time of arrival at the point of observation. So far the results seem to show that the more recent measurements of Tigerstedt, Stolnikow, etc., are too low, while those of the older observers (Volkmann, etc.) are too high.

As a preliminary to this investigation the author shows that when the time of injection is not too short it is approximately equal to the time of passage of the altered blood through a given cross-section of the carotid or femoral artery. The circulation time of the lungs, as determined by the injection of methylene blue in rabbits and of NaCl by the telephone method in dogs, is approximately the mean pulmonary circulation time and not the minimum. This is also the case for such artificial schemes as approach the condition of a vascular capillary tract.

Demonstrations of apparatus. G. W. FITZ.

1. A spring cylinder chronograph for spark records.

2. A lever system to illustrate the action of muscles in relation to joints.

3. A form of student's myograph.

4. A modification of the location reaction apparatus.

Demonstration of preparations of the nerve cell under acute alcoholic poisoning. C. F. HODGE (for C. C. Stewart).

Specimens to illustrate Mr. Stewart's recent paper (Journal of Experimental Medicine, Vol. I., No. 4, 1896) were demonstrated to the Society. In the experiment cats were used, one being held in alcoholic stupor for 54½ hours, a second 50 minutes, death being caused by alcoholic poisoning in both cases, and a third being killed by decapitation. From the three animals, thus dead at the same time, corresponding portions of the nervous systems were removed and immediately placed in the same dishes of the several fixing and hardening

reagents employed. The sections demonstrated were those obtained from the cerebrum, cerebellum and spinal cord by the alcohol-methylene-blue method. It was easily observable, even by the unaided eye, that the sections from the normal animal stained much more deeply than those from either of the animals killed with alcohol. Material from the animal killed in 50 minutes was also easily seen to be stained somewhat more deeply than that from the animal killed in 54½ hours. Methylene blue, as thus applied, has been found to be especially good for staining the granules in the cell protoplasm. Absence of stain in the alcoholic material would thus seem to indicate that alcohol, as above applied, had either destroyed the characteristic granulation of the cell protoplasm or so changed the cell contents that it is no longer able to hold the stain.

Prof. W. H. Howell proposed the following resolutions regarding the work of the late Prof. H. Newell Martin: "The members of the American Physiological Society have heard, with profound regret, of the death of Prof. H. Newell Martin. In commemoration of his distinguished services the Society adopts and places upon its official record the following expression of its appreciation and esteem. In the death of Prof. Martin the Society has lost a member to whom it owes an especial debt of gratitude. He was actively concerned in its foundation and organization, and during the critical period of its early history he gave much time and thought to its interests. He served for six years as its Secretary and Treasurer, and strove always with enthusiasm to make a successful beginning of an enterprise which he believed would foster the spirit of scientific research in physiology and bring its active workers into stimulating fellowship. For its present prosperous condition and its prospects of future usefulness the Society feels that it is largely indebted to his wisdom and energy. In a broader field his influence upon the science of physiology has been deeply felt. His own splendid contributions to experimental physiology will have an enduring value, while the stimulus given by him to others has been, and will continue to be, an influential factor in the development of physiological instruction and research in this country. As an investigator and teacher he was distinguished not only by his originality and ability, but by many noble traits of character. His modesty, his genuine interest in all kinds of biological work, his steady insistence upon the highest ideals of scientific inquiry, his chivalrous conception of the credit due to his fellow-workers, and the generous sympathy and appreciation always felt and shown by him for the work of younger investigators, are some of the qualities which will endear his memory to those who were so fortunate as to be brought into intimate association with him as teacher or as friend."

Prof. H. P. Bowditch, in seconding the resolution, said: "Probably few of the younger members of the Society are aware of the great debt which we owe to Dr. Martin for establishing the high standard which the Society has always maintained with regard to the qualifications of the members. It was always Dr. Martin's contention that a candidate for admission to our ranks should be required to demonstrate his power to enlarge the bounds of our chosen science, and not merely to display an interest in the subject and an ability to teach text-book physiology to medical students. To his wise counsel in this matter the present prosperity of the Society is, I think, largely to be attributed. I trust that the resolution will be adopted and spread upon the records of the Society."

The resolution was unanimously adopted.

A cordial invitation to the members of the Society to join the British Association

for the Advancement of Science at its Toronto meeting in August, 1897, was received and accepted with thanks.

The following gentlemen were elected to membership: Prof. A. B. Macallum, M. B., Ph.D., Toronto University; Prof. W. S. Carter, M. D., University of Pennsylvania; L. B. Mendel, Ph.D., Yale University.

The following officers were elected: Council: R. H. Chittenden, Yale, President; F. S. Lee, Columbia, Secretary and Treasurer; H. P. Bowditch, Harvard; W. H. Howell, Johns Hopkins; W. P. Lombard, Michigan.

FREDERIC S. LEE,
Secretary.

COLUMBIA UNIVERSITY.

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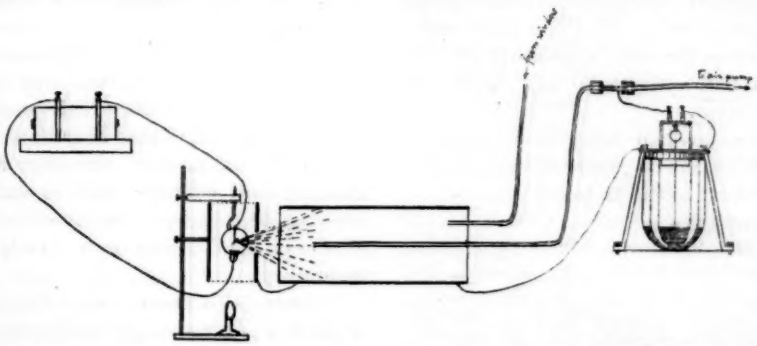
*ELECTRIFICATION OF AIR BY RÖNTGEN RAYS.**

To test whether or not the Röntgen rays have any electrifying effect on air, the following arrangement was made.



A lead cylinder 76 cm. long, 23 cm. diameter, was constructed; and both ends were closed with paraffined cardboard, transparent to the Röntgen rays. Outside the end distant from the electrometer (see diagram) a Röntgen lamp† was placed. In the other end two holes were made, one in the middle, through which passed a glass tube (referred to below as suction pipe) of sufficient length to allow the end in the lead cylinder to be put into any desired place in the cylinder. By means of this, air was drawn through an electric filter* by an air pump. The other hole, at a little distance from the center, contained a second glass tube by which air was drawn through india rubber tubing from the open-air quadrangle outside the laboratory.

In one series of experiments the end of the suction pipe was kept in the axial line of the lead cylinder at various points 10 cm. apart, beginning with a point close to the end distant from the Röntgen lamp.

In every case the air drawn through the filter was found to be negatively electrified when no screen or an aluminium screen was interposed between the Röntgen lamp and the near end of the lead cylinder. The air was found not electrified at all, or very slightly negative, when a lead screen was interposed.

When the Röntgen lamp was removed or stopped, and air was still pumped through the filter, no deflection was observed on the electrometer. This proved that the air of the quadrangle was not electrified sufficiently to show any deflec-

* Read before the Royal Society of Edinburgh, Monday, December 21, 1896. From proof-sheets of *Nature*, contributed by Lord Kelvin.

† The Röntgen lamp was a vacuum vessel with an oblique platinum plate (Jackson pattern).

* Kelvin, Maclean, Galt, Proc. R. S., London, March 14, 1895.

tion when thus tested by filter and electrometer.

Similar results were obtained with the end of the suction pipe placed so as to touch the floor of the lead cylinder, or the roof, or the sides. Whether the air was pumped away from a place in the cylinder permeated, or from a place not permeated, by the Röntgen rays, it was in all cases found to be negatively electrified.

The following are some of the results obtained on December 16th and 17th. The electrometer was so arranged as to give 140 scale divisions per volt.

Conditions.—Large lead cylinder metallically connected with sheath of electrometer. Röntgen lamp surrounded by a lead sheath, which latter was also connected to electrometer sheath. There was a window in this lamp sheath 2.5 cm. broad and 5 cm. high. This window could be screened by aluminium or by lead. These screens were always connected metallically to sheaths. During all the experiments a Bunsen lamp was kept constantly burning, with its flame about 30 cm. below the Röntgen lamp.

Results.—Röntgen lamp in action; air drawn from lowest point of end of lead cylinder next to the R. lamp.

December 16, 3.55 p. m.

—61 scale divisions in 2 mins. with aluminium screen.
—63 " " " 2 " " no screen.
—14 " " " 2 " " lead screen.

4.20 p. m. Air drawn from point on lower line of lead cylinder 26 cms. distant from R. L. end.

—14 scale divisions in 2 mins. with lead screen.
—78 " " " 2 " " no screen.
—24 " " " 2 " " lead screen.
—83 " " " 2 " " alumin. screen.
—13 " " " 2 " " lead screen.

December 17.

R. L. acting, and air drawn through filter.

						End of suction pipe kept in axial line of cylinder. cms.		
10.47 a. m.								
—44	in	2 mins.	with	alumin.	screen,	68	from	R. L. end.
0	"	"	"	lead	"	68	"	"
—28	"	"	"	no	"	58	"	"
—24	in	2 mins.	with	no	screen,	48	from	R. L. end.
0	"	"	"	lead	"	48	"	"
—23	"	"	"	alumin.	"	48	"	"
—26	"	"	"	alumin.	"	38	"	"
— 9	"	"	"	lead	"	38	"	"
— 7	"	"	"	lead	"	28	"	"
—26	"	"	"	alumin.	"	28	"	"
—36	"	"	"	alumin.	"	18	"	"
—21	"	"	"	alumin.	"	8	"	"

We had previously made experiments with a sheet-iron funnel 1 metre long, 14.5 cms. diameter; and with a glass tube 150 cms. long, 3.5 cms. diameter; and with an aluminium tube 60 cms. long, 4.5 cms. diameter. Air was pumped from different parts while the Röntgen rays were shining along the tubes from one end, which was closed by paraffined paper stretched across it. In every case the air was found to be negatively electrified.

In those earlier experiments the air drawn away was replaced by air coming in from the laboratory at the open end of the tube. We found evidence of disturbance due to electrification of air of the laboratory by brush discharges from electrodes between the induction coil and Röntgen lamp, and perhaps from circuit-break spark of induction coil. These sources of disturbance are eliminated by our later arrangement of lead cylinder covered with cardboard at both ends, as described above, and air drawn into it from open air outside the laboratory.

We have also found a very decided electrification of air—sometimes negative, sometimes positive—when the Röntgen rays are directed across a glass tube or an aluminium tube, through which air was drawn from the quadrangle outside the laboratory, to the filter.

A primary object of our experiments was to test whether air electrified positively or negatively lost its charge by the passage of Röntgen rays through it. We soon obtained an affirmative answer to this question, both for negative and positive elec-

tricity. We found that positively electrified air lost its positive electricity, and in some cases acquired negative electricity, under the influence of Röntgen rays; and we were thus led to investigate the effect of Röntgen rays on air unelectrified to begin with.

Note on diagram.—For the sake of simplicity, the screening of the electrometer is not shown in the diagram. In carrying out the above experiments, however, we have found it absolutely necessary not only to surround the electrometer with wire gauze in the usual manner, but we have had also to place a sheet of lead below it, and to screen also the side next the Röntgen lamp by a lead screen. In some cases it was even necessary to cover up the whole with paper to prevent the electrified air of the room from disturbing the instrument.

KELVIN,
J. C. BEATTIE,
M. SMOLUCHOWSKI DE SMOLAN.
PHYSICAL LABORATORY,
UNIVERSITY OF GLASGOW,
December 19, 1896.

CURRENT NOTES ON ANTHROPOLOGY.

ORIGIN OF ROCK PAINTINGS.

A VALUABLE article is published in the Bulletin of the American Museum, Vol. VIII., by James Teit, on a rock painting of the Thompson River Indians, British Columbia.

It appears that young girls, on reaching maturity, retire for a season of solitude, meditation and purification. At its close they paint on some rock, with red ochre, their psychical experiences and the rites they have performed. An example is given with its interpretation.

This origin of pictographs is not mentioned, I think, in Col. Garrick Mallery's extensive work. The figures are curious and suggestive. They appear to be conventional and can be read by any woman of the tribe. This shows that they are taught to the young girls, and we thus find a recognized graphic system prevailing in this rude tribe.

THE MEANING OF MOURNING.

VARIOUS ethnologists have claimed that the laments, the mutilations and howls of the survivors around the corpse in primitive nations are chiefly for their own benefit, to keep away the ghost, as that is usually considered malevolent.

The subject is discussed by K. T. Preuss, in the *Globus*, November, 1896, in an article 'Die Totenklage im alten Amerika.' Some instances, he believes, justiy the above assertion, but the majority do not. The wailing and weeping, often continued for months, he regards as generally indications of personal sorrow at the loss sustained.

This natural and satisfactory explanation is supported by the most intelligent officers of our regular army who have seen intimately the home life of our western Indians. For instance, the late Captain W. P. Clark, 'the white chief with the talking hand,' expresses himself positively to this effect, in his *Indian Sign Language*, p. 263.

PRIMITIVE TRAVEL AND TRANSPORTATION.

AN essay with this title, by Prof. O. T. Mason, occupies more than 350 pages of the last Report of the United States National Museum. In completeness of presentation and wealth of material it far surpasses any other study of the subject, and leaves little to be desired until we have materially extended our collections of early objects. There are 260 figures inserted in the text, illustrating all sorts of native conveyances —cradles, baskets, shoes, sandals, staffs, carrying gear, tree-climbing devices, snow goggles, etc.—and the mode in which they were used. Roads, bridges, journeys, camping grounds and other matters pertaining to primitive travel claim a part of the author's attention.

Prof. Mason intends to follow up this excellent piece of work with a primitive trade-route map of the United States and Canada, including trails and portages. He will be gratified to receive information on these points from travelers and explorers, or references to where such may be found. His address is the National Museum, Washington, D. C.

D. G. Brinton.
University of Pennsylvania.

SCIENTIFIC NOTES AND NEWS.

MODERN ARMY RIFLES.

The portions of the Governor's message of January, 1895, to the Legislature of the State of New York referring to the re-arming of the State troops; the Law passed May 10th, in compliance with its suggestions, and the rules of procedure of the New York State Board appointed to select improved arms for the militia of the State; the report of that Board, September, 1895, and the Governor's message of October 22d, relating to the report, are just published in pamphlet form by the Savage Arms Co., of Utica, N. Y., the makers of the gun selected by the Board. This makes a convenient compendium for those interested in the subject. A table is also included showing the dimensions and character of the rifles adopted for military purposes by the governments of the world; substantially all of which have adopted a small calibre, usually about 0.30 inches, and smokeless powder. The United States has accepted this specification for its army rifle, but the navy gun is of but 0.236 inches bore. Curiously enough, all of the States of the Union have armed their troops with the U. S. Springfield gun, except New York, which has the most antiquated of rifles, of large calibre; and all the militia of all the States are using black powder.

The N. Y. State Board reported in favor of a 'lever action,' in preference to the 'bolt action' adopted by all the nations of Europe, as being in all respects superior to the latter and as having the further advantage of being a generally used American invention, and hence familiar, already, to all habitual users of the rifle in the United States. A stronger metal for barrels than heretofore employed is specified, and the study of nickel steel as a material for such guns is advised. That alloy is already adopted by the United States Navy, both for small arms and for ordnance and armor. The Board suggests the attempt to secure at least an elastic limit of 75,000 pounds per square inch, tenacity of 110,000 or 120,000 pounds, and at the same time a ductility of at least 20 per cent. in eight inches. It is thought possible to secure these figures, which would insure an extremely strong, yet light and very safe, barrel. The United States Army regulation bore, chamber and rifling are advised, in order to secure uniformity of ammunition. The Board seems doubtful whether the higher velocity, approximating 2,300 feet per second, greater range, attaining something like two miles, and higher penetrative power of the small bores used by our own navy, and by several foreign nations, is not, on the whole, compensated by more serious disadvantages in loss of 'stopping power' and difficulties of manufacture and manipulation. The gun selected has a muzzle velocity of 1,950 feet and a range of about a mile and a-half.

The use of the 'clip' for holding cartridges is not found desirable, with a satisfactory form of magazine and mechanism. The use of the gun as a single loader, with a reserve in the magazine, is thought likely to prove, in action, the usually desirable arrangement.

Twelve guns were entered for examination and report. Their behavior under test, according to the statement of the Board, "is believed to have been the most wonderful performance of new magazine rifles of different patterns of which a record is known. It was a splendid exhibition of American skill and genius in the invention of effective military magazine arms."

The report is unanimous and is signed by Messrs. Albert D. Shaw, of Watertown; E. W. Bliss, of Brooklyn, and R. H. Thurston, of Ithaca, N. Y.

GENERAL.

The cable dispatch (see page 103 in the last number of this Journal) regarding the disposition of the fortune of the late Alfred Nobel is confirmed by later advices. The annual income

will amount to about $300,000, and four-fifths of this sum is to be spent in four prizes for advances in science. The competition will be open to Scandinavians and foreigners on equal terms. All men of science will look forward with great interest to learning the details of this bequest—probably the most noteworthy ever made for public purposes—and the methods to be followed in awarding these great prizes.

THE widow of Baron Maurice Hirsch, of Vienna, has resolved to present about $400,000 to the Pasteur Institute as a memorial of her husband. Part of this sum will be used for building chemical and biological laboratories.

THE will of the late Robert H. Lamborn, which bequeathes about $200,000 to the Academy of Natural Sciences of Philadelphia, has been admitted to probate.

IT was reported at the Frankfort meeting of the German naturalists and physicians that 255,000 Marks had been collected for the memorial to the eminent chemist von Hoffmann. This will be used for the erection of a building to be known as the 'Hoffmann Hausa,' to be used as the headquarters of the German Chemical Society. It is proposed to establish in it a laboratory and a library, which latter includes the books left by von Hoffmann.

THE late General Cullum left $100,000 to the American Geographical Society, New York, for a building, and also bequeathed a further sum, to be known as the Cullum Geographical Medal Fund, for a gold medal to be given to those who should render most distinguished services to geographical science, and particularly to American citizens. The first medal has been awarded to Mr. R. E. Peary, U. S. N., for having established the insularity of Greenland.

PROFESSOR BEHRING has been awarded the Rinecker prize consisting of a gold medal and 1000 Marks by the University of Würzburg, for his discovery of the Anti-toxin treatment of diptheria.

THE British Institute of Public Health has awarded the Harben medal for 1897 to Professor M. von Pettenkofer, emeritus professor of hygiene in the University of Munich.

THE Bressa prize of the Reale Accademie delle Scienze, of Turin, will be awarded for the eleventh time in 1899. The prize, which is of the value of nearly $2,000, is given for the most important scientific work produced during the years 1895–98. Competitors must send their contributions in print before the end of the present year. The academy reserves the right to award the prize to one who has not entered his name among the competitors.

A STATUE of the late Samuel Gross, the eminent Philadelphia surgeon, will be unveiled at the Triennial Congress of American Physicians, to be held in Washington in May. The statue will be in the grounds of the Smithsonian Institution, near the Army Medical Museum.

THE deaths are announced of Mr. G. F. Schacht, who made improvements in the application of certain drugs to the treatment of disease, at the age of seventy-three years; of Dr. Liugi Calori, professor of anatomy at Bologna, at the age of eighty-nine years, and of Mr. R. Warner, an English horticulturalist, at the age of eighty-two.

THE Chemical Society of Washington, at its thirteenth annual meeting, elected the following officers: President, W. D. Bigelow; Vice-Presidents, H. N. Stokes and Peter Fireman; Secretary, V. K. Chesnut; Treasurer, W. P. Cutter, and Executive Committee, C. E. Munroe, E. A. de Schweinitz, Wirt Tassin and W. G. King.

COLONEL CARROLL D. WRIGHT, United States Commissioner of Labor, has been chosen President of the American Statistical Association, at its annual meeting. The position was left vacant by the death of General F. A. Walker, who had filled it for fourteen years.

DR. G. H. SAVAGE has been elected President of the Neurological Society of London. The subject of his inaugural address, which was to have been given on January 14th, is 'Heredity in the Neuroses.'

THE London correspondent of *Garden and Forest* states that the Royal Horticultural Society continues to provide lectures for its bimonthly meetings at the Drill Hall, and that the bulk of them are a success. Next year's program contains some items of more than usual interest, namely: 'Microscopic Gardening,' by Prof. Marshall Ward, of Cambridge; 'Artificial

Manures,' by Mr. J. J. Willis; 'Diseases of Orchids,' by Mr. G. Massee, F.L.S., of Kew; 'Physiology of Plants,' by Prof. S. H. Vines, of Cambridge; 'Mutual Accommodation between Plant Organs,' by Prof. G. Henslow; 'Roots,' by Prof. F. W. Oliver, and 'Sporting in Chrysanthemums,' by Prof. Henslow. In addition to these scientific lectures by eminent specialists, there will also be lectures upon practical subjects by leading practitioners. These lectures are all published afterwards in the Society's journal. The great exhibition at the Temple is announced for May 26th, 27th, 28th, and the exhibition of fruit at the Crystal Palace for Sept. 30th and Oct. 1st and 2d.

At the close of the thirtieth volume of *The American Naturalist* Prof. J. S. Kingsley, of Tufts College, and Prof. C. O. Whitman, of the University of Chicago, withdrew from the board of editors. Dr. F. C. Kenyon, of Philadelphia, takes the place of Prof. Kingsley as managing editor, with Prof. E. D. Cope. The *Naturalist* has, in its long history, witnessed unparalleled advances in the biological sciences, and will continue to be an important factor in the further progress that is assured.

Die Umschau is the title of a new weekly journal, devoted to pure and applied science, literature and art, published at Frankfort by Bechhold, and edited by Dr. J. H. Bechhold. The journal proposes to give a complete and reliable review in plain language of the advances in all the sciences. The first number includes articles by William Huggins on the physics of celestial bodies; by T. H. Achilles, Max Buchner and J. W. Bruinier on anthropological subjects, and by Prof. Eulenberg on the treatment of neurasthenia.

The *Journal of Nervous and Mental Diseases*, New York, will hereafter be edited by a board consisting of Dr. Charles L. Dana, Dr. F. X. Dercum, Dr. Philip Coombs Knapp, Dr. Chas. K. Mills, Dr. Jas. J. Putnam, Dr. B. Sachs and Dr. M. Allen Starr, with Dr. Ph. Meirowitz and Dr. Wm. G. Spiller as associate editors and Dr. Charles Henry Brown as managing editor.

The Macmillan Company announces as in preparation an *Encyclopædia of American Horticulture*, to be edited by Professor L. H. Bailey.

The Agricultural Appropriation Bill was presented to the House of Representatives on January 13th, by Mr. Wadsworth, Chairman of the Committee on Agriculture. The total appropriation recommended is $3,152,752, an increase of $102,780 over the amount appropriated for the current year. The increase is chiefly for the Bureau of Animal Industry, to be used in the inspection of meat. $120,000 is appropriated for the purchase and distribution of seeds, and the Secretary is directed to expend the appropriation. It is well known that Secretary Morton is opposed to this expenditure, and the item has been inserted in the bill without his sanction.

Mr. Chas. D. Walcott, Director of the U. S. Geological Survey, has asked for an immediate appropriation of $25,000 for the preparation of a map of the gold and coal areas of Alaska.

The Massachusetts Board of Agriculture has submitted to the General Court the report of the Gypsy Moth Commission. Mr. C. H. Fernald, the entomologist of the Board, recommends that $200,000 be granted for the work, and holds that if this appropriation be given for five years, with a smaller appropriation for ten years more, the pest can be exterminated. It can be held in check for $100,000 annually. If nothing is done the moth will spread rapidly in Massachusetts and elsewhere, and will cause great destruction.

Botanists and zoologists will learn with interest that a Biological Survey of Alabama has been organized and put into operation. The survey will be carried on under the auspices of the Alabama Polytechnic Institute, and will be manned by the specialists engaged at that institution in the various lines of biological investigation. It will have for its object the study in field and laboratory of all plants and animals occurring in the State, and of the various conditions affecting them. The work will be done sytematically and thoroughly and all results published. In a region so interesting and little known as this portion of the Southern United States, careful and extended research will be sure to yield results of great value.

Large quantities of material in all groups of plants, and animals (especially insects), will be collected and properly prepared. In connection with the survey there has been founded an Exchange Bureau, from which will be distributed all duplicate material. Those desiring to correspond relative to specimens, literature, or the work of the survey, should address: *Alabama Biological Survey, Auburn, Alabama.*

REUTER'S Agency is informed that Mr. Moore, of the Royal Society, has returned from Tanganyika. Mr. Moore was sent out by the Society early in 1895 to examine the fauna of Lakes Nyasa and Tanganyika. On account of the remarkable specimens of jelly-fish which have been sent home at different times by Mr. A. J. Swann and Captain Hore, the idea was formed that Lake Tanganyika must have once had some connection with the sea and still retained its partially marine fauna. Mr. Moore's researches completely confirm this view. The explorer is stated to have found not only remarkable marine jelly-fish and deep-sea fish, but also sponges in Lake Tanganyika. Mr. Moore will remain for about three weeks at Naples, in order to repack his collection before going on to London.

THE report of the Pasteur Institute for the quarter ending June 30th states that the total number of persons under treatment was 316, of which six died. Only twenty-three of the patients were foreigners.

A CHEMICAL laboratory has been fitted up in the top floor of the extension of the Boston State House, to be used by the State Board of Health for the analysis of water and other purposes.

THE London *Times* states that the Trustees of the British Museum have recently acquired, by purchase, a remarkable specimen, nearly 10ft. high, of the great extinct wingless bird, the moa (*Dinornis maximus*), from New Zealand. The intrinsic interest of this particular specimen rests on the ground that the skeleton is that of a single individual, unmixed with the bones of any other bird of the species. In this respect it is, indeed, extremely rare, not more than three, or at least four, similar examples being known. There are, of course, several other specimens of *Dinornis maximus* to be seen in the British and other museums, but these have all been reconstructed from bones belonging to more than one individual. The skeleton now at South Kensington was discovered by Captain F. W. Hutton, F.R.S., Curator of the Canterbury Museum, New Zealand, who, in conducting some excavations at Invercargill, Southland, came across the largest and most varied collection of moa bones ever obtained from one place, representing probably not fewer than 800 birds, none of them belonging to still living species.

IT is reported that motor carriages are to be introduced into New York in April by the New York Cab Company, compressed air being used to drive the carriages. The Hackney Vestry, London, is considering the use of motor vans and carts for watering the streets, collecting garbage, etc.

ELABORATE arrangements are being made for the International Horticultural Exhibition which will be held in Hamburg from May 1 to September 30, 1897. Besides a general permanent exhibition, outdoor and indoor, open throughout the summer, arrangements have been made for special exhibitions of plants, etc., at different seasons. The permanent exhibition will consist of various classes of trees, shrubs, herbaceous plants, groups of plants, technical appliances, garden plants, preserved fruits, wines and dried flowers and grasses. The dates of the special exhibitions are as follows: (1) Spring exhibition from May 1 to 7, 1897, for plants in season; (2) First special exhibition, May 30th to June 3d, for pelargoniums, floral arrangements, early vegetables; (3) Second special exhibition, July 2d to 6th, for gloxinias and other bulbous plants, roses (cut flowers), cut flowers or twigs of trees and shrubs, floral arrangements (to consist chiefly of roses; (4) Third special exhibition, July 30th to August 3d, for begonias, carnations, cut flowers (dahlias, gladioli and carnations), fruit trees in pots; (5) Autumn exhibition, August 27th to September 5th, for plants in season in pots (groups, single plants, novelties, etc.), floral arrangements, vegetables; (6) Fruit exhibition, September 17th to 30th.

MR. JOHN MILNE has recently advocated an earthquake survey of the world. He states that for $5,000 twenty observatories willing to co-operate can be provided with the necessary instruments, and calls attention to the important theoretical and practical problems that can thus be solved. One of the recent earthquakes in Japan was recorded about 16 minutes after its occurrence in Mr. Milne's observatory on the Isle of Wight, and showed that there had been an error in telegraphic transmission to the newspapers of two days, whilst another gave an accurate account of a catastrophe the details of which were not known until mails arrived some three weeks later. An absence of records from the Isle of Wight seismographs has on more than one occasion shown that telegrams have exaggerated seismic effects, and in one instance at least—referring to a recently reported disaster in Kobe—indicated that the sender, regardless of the alarm he might create, was without foundation for his widely-published message. The immediate benefits derived by observatories at which instruments were installed, over and above the speedy announcement of great catastrophes in distant places, would be that the records of earth movements would throw light upon some of the otherwise unaccountable deflections shown in diagrams from magnetographs, barographs and other instruments sensible to slight displacements, whilst diurnal and other changes in level affecting astronomical observations would be countinuously recorded.

MR. BENNETT, who is acting as British Consul-General at Galatz, has prepared, says the London *Times*, a report on the petroleum industry in Rumania, where, he thinks, it is likely to play an important part in future commercial development. Petroleum exists in abundance in Rumania, in the zone stretching from Turn-Severin, on the western frontier, along the foot of the Carpathians, towards Bukowina and Galicia. It is found throughout the whole of this region, but especially in the Olt, Dimbovitza, Prahova, Buzeu and Tazlau valleys. It is said also to be found in the whole of the plains down to the Danube. There are about fifty borings and eight hundred wells dug by hand in the five districts above mentioned; but these are all shallow, and the output in 1894–95 reached 800,000 tons. Although petroleum has been worked in Rumania for 25 years, the industry is evidently in its infancy still. The greater part of the land is owned by the state and large holders who reside in the towns and will not invest money in industrial enterprise; grain has monopolized the energy and capital of the Rumanians, and the forests and mineral wealth of the country are neglected. Thus it was not until 1895 that a mining law was passed, and up to that date the ownership of land below the surface had never been determined. Nor is there a body of native mining engineers. About a third of the crude oil is taken from the wells of four firms, while the remainder comes from the workings of numerous small proprietors, who heve not the capital necessary for proper development of the deposits.

UNIVERSITY AND EDUCATIONAL NEWS.

THE Johns Hopkins University has published the twenty-first annual report of President Gilman. The report itself, presented to the trustees on November 21st, extends to sixteen pages only, but there are two appendices. One of these contains the reports on the chief branches of study prepared by the principal instructors in the several departments, together with statements regarding the library, the press, the State Weather Service, The State Geological Survey and the marine laboratory. In conclusion there is given an interesting retrospect of the twenty years now completed by the University. The important service performed by the Johns Hopkins University for education and science in America is adequately witnessed by the fact that nearly half of its students have become teachers. The following institutions have on their staff more than ten students from the University: Johns Hopkins University (67), Chicago (23), Wisconsin (19), Bryn Mawr (18), Leland Stanford, Jr. (17), Michigan (17), Pennsylvania (16), Cornell (14), Columbia (13), Massachusetts Institute of Technology (11), Nebraska (11), Northwestern (11), Harvard (10), Woman's College of Baltimore (10).

THE faculty of the Massachusetts Institute of

Technology, on January 13th, elected Professor James M. Crafts, of the chemistry department, chairman *pro tem.* of the faculty, pending the election of a successer to the late Gen. F. A. Walker as President.

MR. G. A. HOBART, Vice-President elect, has given $5,000 to Rutgers, of which he is a graduate.

DISCUSSION AND CORRESPONDENCE.

A NATIONAL DEPARTMENT OF SCIENCE.

TO THE EDITOR OF SCIENCE: I have just seen in the current number of SCIENCE Dr. Dabney's discussion of this subject, and, feeling that the natural inferences most persons unacquainted with government work would draw from it, must be not only inaccurate but mischievous, I feel obliged to point out that there are at least two sides to the question, and it is extremely doubtful whether the establishment of such a department would be beneficial to science, economical or efficient to a degree warranting the change.

With much that Dr. Dabney has written I am in accord; it is his conclusions, and the inferences to be drawn from his manner of presenting the facts, that demand further examination.

It is nothing new for people to assume that the proposal of a new set of well chosen names, a new classification of well known facts, or a cleverly drawn scheme of organization of previously distinct agencies, has in itself added something to knowledge, or possesses an inherent power of some undefined sort to make things easier, cheaper or better. Such assumptions are at the basis of nearly all cranky theories, as well as occasional good ones. No scientific man should accept such hypotheses without a thorough investigation of the facts.

I take it that the object of a scientific bureau is to gather, digest and disseminate facts in regard to matters with which it is officially charged. If this work is done promptly, efficiently and accurately, at a reasonable cost, the bureau justifies its existence, and not otherwise. It is of no consequence, whatever, to the bureau and its work whether it is attached to one department or another, or to none, if the bureau is conducted by a competent person on scientific principles, and with a view simply to getting the best possible results. The origin and success of our scientific bureaus has been due, as Dr. Dabney points out, to the fact that they are, in the main, the crystallized result of individual effort exerted in a particular field and with the object of attaining certain definite ends.

The men to whom we owe our best scientific agencies under government, worked, and often gave their lives prematurely, not to get offices, or titles, or salaries, or to add a new name to the lists of bureaus in the blue books, but to promote research and benefit the nation by its results. This, too, has been the object of their successors in conscientious devotion. The danger and difficulty which has threatened the bureaus, and never more than at the present time, has been the intrusion of politics or personal interest in appointments, and the stifling of individual initiative by an excess of red tape, imposed generally in good faith by Congress with the idea of preventing abuses.

From Dr. Dabney's account it might be supposed that a number of bureaus were, to a greater or less extent, duplicating each other's work, and the inference is direct from his argument that this duplication might and should be prevented by a consolidation of the various bureaus. The supposition is, I believe, quite erroneous and the inference wholly fallacious.

The bureaus exist to do work, and the advisability of any change in organization must be measured by its capacity for increasing results, improving efficiency, and promoting economy without lessening the product measured in results. If consolidation would diminish results, impair efficiency, and do away with individual responsibility to any marked degree, it would be dearly bought. That this would be the case, under present conditions, there can be hardly any doubt; and the coolness with which the proposition, which is by no means new, has been met in Congress is, I am convinced, due to the fact that the more influential members, as good business men, recognize that the hypothesis is without the essentials of a workable scheme.

At present most of the bureaus are attached to some department. The head of that department has many divisions to supervise. In general, even if not specially interested in science

he is a man of broad views and good executive capacity. After satisfying himself that the proper official safeguards are observed in the bureau and that the head of it is competent and of good report, the Secretary rarely meddles with details—in fact, has no time to waste upon them.

The Director of the bureau can devote his energies to carrying on its work and maintaining proper supervision of details. If it is a bureau in which, say, chemical work is required, the laboratory occupies part of the quarters of the bureau, its operations are immediately adjacent to the offices of men whose work is being supplemented by chemical research, the supplies for the chemist are only those required for the work he is doing, and the latter is promoted by the constant opportunity of conference between the people interested. An experiment can be ordered, immediately taken up, the process altered or the scope enlarged while actually in progress, or it can be stopped to take up something of instant importance; in short, the laboratory is a tool in the hands of the bureau, which can be directed to exactly the work which is required without delay, interruption or interference. This promotes efficiency and the progress of science.

It is true that an unfriendly Secretary might wreck the scientific work of a bureau by getting rid of a competent and installing an incompetent Director. But this danger is not obviated by the suggested consolidation, and cannot be by anything short of a cordial acceptance of the merit principle of civil service reform by the whole executive body of the government. We are all agreed that that will be a happy day, but also that it has not yet dawned.

The head of the proposed department is to be a Cabinet officer, and hence necessarily changed with the changes of administration. It follows that he will be more or less of a politician and his appointment obtained by political methods. Having no other executive duties, and it being impossible that he should have a working knowledge of all of the scientific branches under his control, the tendency to meddle and modify would be almost irresistible. The Directors of the several bureaus, instead of attending to their business, would have to occupy themselves in protecting it against ill-advised interference.

The chemical laboratories being consolidated, the chief chemist would be a greater man than any of his colleagues. No Director of a bureau could control his own chemical work. With demands for particular jobs from several bureaus on hand it would be wholly uncertain when any of them would be finished. Complaints would be met by playing one off against another. Responsibility, and, to a large extent, efficiency, would be lost. Meanwhile no fewer men could do the chemical work than were required before. Instead of the quarters being included in the rent of the several bureaus, as now, a large and separate building would be called for and required. That a dollar would be saved by such a proceeding is doubtful. That delays and inefficiency would be inevitable is certain. It may be said that the above is a pessimistic view, but we have in the government printing office a brilliant example of the effects of consolidation, where it takes six months to a year to get a scientific book printed, and there is no responsibility whatever to the Department, whose work is entirely at the mercy of the public printer, who knows no superior and does as he likes. Those who have had experience with his office do not desire any further consolidations of the same kind.

Of course, the chemical laboratory has been merely taken as an illustration. The writer has nothing to do with such laboratories, but the principle holds good throughout.

Dr. Dabney has spoken of other instances of supposed duplication of work, or rather two parties doing the same kind of work. Any genuine duplication could be cured at once if pointed out, but, as before stated, the duplication is not real but nominal. Different sorts of work are called by the same name. There is no point of contact between the hydrology of the Geological Survey and the hydrography of the Navy Department. Methods which would disgrace the Coast Survey work have always been regarded as entirely sufficient in the Land Office. One kind costs twelve cents a mile, the other two hundred dollars. These are not duplications.

I do not for a moment claim that our govern-

mental methods are perfect, or that well considered changes may not in some cases be wholly desirable. All I desire to do is to point out that the nostrum now offered is by no means a cure-all, and that the attainment of ideal conditions depends almost wholly on an honest recognition by the whole country, as represented by Congress and the executive, of merit, fitness and resulting permanency of tenure in the staff of the scientific bureaus.

WASHINGTONIAN.

WASHINGTON, January 16, 1897.

THE JURASSIC WEALDEN (TITHONIAN) OF ENGLAND.

PROF. O. C. MARSH has called again attention to the Wealden formation of England—an abnormal deposit, rather puzzling. Every observer working at geographical geology and general classification has been struck by an enigma in the otherwise classical classification of the strata of England. Between the Portland stone at the island of Portland and at Durstone bay, and the Lower Greensand of the Middle Cretaceous, we have a series of beds, mainly sands and clays, with some limestone and dirt in the inferior part, which has been called a fluvio-marine and fresh-water formation, of a thickness of about 1,500 or 2,000 feet, designated generally by the name of Wealden. The name of 'Weald formation, or Wealden,' was first introduced in the English classification by P. I. Martin in 1828 (*A Geological Memoir on a Part of Western Sussex*, p. 40, 4to, London).

Dr. William H. Fitton accepted it, and in his celebrated memoir, *Observations on some of the strata between the Chalk and the Oxford oolite in the Southeast of England*, Trans. Geol. Soc. London, second series, Vol. IV., p. 103, London, 1836, gives a detailed account, dividing the Wealden into three great groups, called the Purbeck strata, Hastings sand and Weald clay proper.

Dr. Gideon A. Mantell is generally credited as the author of the stratigraphic position in English classification of the Wealden formation (*Illustrations of the Geology of Sussex*, 4to, London, 1827, and *A sketch of the Geological structure of the Southeastern part of Sussex*, Lewes, 1818). He puts it as the lowest part of the Cretaceous formation.

The classification of Mantell was generally accepted until November, 1849, when Edward Forbes observed at Portland and Swanage that Fitton and Mantell made mistakes, especially in regard to the Purbeck marble series, and, after some close and excellent observations, recognized that the Purbeck was Jurassic and not Cretaceous. As he humorously says in a letter to Ramsay: "The 'geology of England' may be 'done' by the old fellows, but it is not overdone yet." (*Memoirs of Edward Forbes*, p. 461, London, 1861.) Edward Forbes was the man to correct errors of classification in regard to the Mesozoic and Tertiary. He has no equal for sharp observations and correct conclusions. Unhappily he was not able to finish his work; his premature death in 1854 arrested completely the researches he inaugurated so well in Dorset and the Isle of Wight. Even his work, as he has entitled it, 'A Description of the Purbeck and Wealden fresh-water and fluvio-marine strata of Dorsetshire and the Isle of Wight, with comparative remarks on synchronous strata elsewhere' (Preface, p. vii., *On the Tertiary fluvio-marine formation of the Isle of Wight*, London, 1856), was never published; only a short notice was given to the public in the British Association Report for 1850, under the title 'On the succession of organic remains in the Dorsetshire Purbecks.' However, short as it is, the notice of Forbes brought the age of the Wealden once more before the English geologists, and one of them who knew best the Secondary or Mesozoic formations, the nephew of the celebrated 'Strata Smith,' Prof. John Phillips, of the University of Oxford, in his remarkable *Manual of Geology*,* pp. 282–318,

* Extract from a letter of Prof. John Phillips to Jules Marcou. * * * "As to the propriety of placing the Wealden in the Cretaceous I have my doubts. Certainly the fresh-water fossil remains, which otherwise are not characteristic of the age of strata, are not in favor of uniting the upper part of the Wealden with the Cretaceous, while the *Megalosaurus* and other Saurians, as well as the fishes and plants found in the Middle (Hastings Sands), protest loudly against the separation of the Wealden from the Oolites." JOHN PHILLIPS.

ST. MARY'S LODGE, YORK, July 23, 1887.

London, 1885, has placed the Wealden formation with its three groups—Purbeck beds, Hastings sand and Weald Clay—into his Oolitic (Jurassic) system.

This classification of John Phillips was not accepted by the Geological Survey of England and the Director-General, the late Sir Andrew C. Ramsay, in his excellent book, '*The Physical Geology of Great Britain*,' fifth edition, pp. 201–212, London, 1878, classifies the 'Purbeck and Wealden strata,' as Lower Cretaceous, saying that the Hastings sands and Weald clay are the fresh-water equivalents in time of the lower and middle part of the Neocomian of Switzerland; adding, 'an assumption' which 'is undoubtedly correct.' Such correlation is inacceptable, for paleontology, lithology and even stratigraphy are wanting entirely, and an 'assumption' cannot replace principles and rules of classification.

Meantime, the true Neocomian has been found in Yorkshire, northwest of Flamborough Head, near Speeton, and described with details and exact correlations by Prof. J. W. Judd in 1868 and 1870, and more recently by Mr. G. W. Lamplugh in 1889 and 1892. Prof. A. P. Pavlow, of the University of Moscow, first in collaboration with Mr. Lamplugh in 1892, and afterward alone in his paper, *On the Classification of the Strata between the Kimmeridgian and Aptian* (Quart. Journ. Geol. Soc., London, Vol. 52, pp. 542–554, London, April, 1896), has given correlations of the Wealden with the Speeton clay and Neocomian of western Europe and Russia. Prof. Pavlow places the Purbeck beds in the Jurassic formations and regards them as the equivalent of the Tithonian of southeastern France.

Now comes the paper of Prof. O. C. Marsh, first read in 1895 at the British Association at Ipswich, and afterward at the National Academy of Science, New York, meeting November, 1896, in which he says that on the vertebrate fauna the Wealden is Jurassic and not Cretaceous.

Many years ago Louis Agassiz had referred some fossil fishes from the Purbeck of England to species of the upper Jura of Switzerland and France. Lately Mr. Smith Woodward, according to Prof. Marsh, has found that the fossil fishes of the Wealden are of Jurassic types; and finally the paleobotanist, Mr. A. C. Seward, after a review of the Wealden plants, says that the evidence is in favor of 'the inclusion of the Wealden rocks in the Jurassic series.' Accordingly, the opinion of Prof. John Phillips, expressed as far back as 1855, is now indorsed by the reptilian fauna, by the fishes and by the fossil plants. Such a concourse of paleontological proofs must correspond with some geographic and stratigraphic facts in the districts of eastern England extending from the island of Portland to Speeton and Filey Bay, in Yorkshire.

During a prolonged visit at Weymouth, in 1870, I was surprised at the small thickness of the Portland stone (only 8 feet) in the celebrated Portland quarries, and at the great development of the Purbeck beds covering the whole Island. As far back as 1858 (*Sur le Néocomien dans le Jura*, etc., Genève) I called attention to the correlation of the Purbeck beds with what was called in France 'Calcaires Portlandiens,' or 'Calcaires de Salins' of Franche-Comté. Since those Portlandian limestones of the Jura have been studied with more detail and exactness in regard to their thickness and the fossils found in them, it is now certain that they constitute a group of strata all younger than the Portland stone of the isle of Portland. The latter are correlated and identical in every way with the 'Marnes Portlandiennes' or 'Marnes de Salins,' containing exactly the same fauna with its most characteristic fossil, the *Exogyra virgula;* and we have now an indisputable horizon, common to southeastern England and France, the Portland stone and the 'Marnes Portlandiennes,' or 'Marnes de Salins,' or zone of the *Exogyra virgula*.

In England before reaching the Speeton clay, undoubtedly Neocomian or Lower Cretaceous, we have above the Portland stone, the three groups of the Purbeck beds, the Hastings sand and the Weald clay. In the Jura Mountains, above the 'Marnes de Salins' with *Exogyra virgula*, we have the 'Calcaires de Salins,' or Portlandian limestones, composed of two groups; the inferior called: 'Portlandien inférieur,' containing a rich fauna, such as: *Nerinea Salinensis, Nerinea grandis, Natica Mar-*

cousana, *Natica Athleta*, *Trigonia Barrensis*, *Trigonia Boloniensis*, *Mytilus portlandicus*, *Mytilus Tombecki*; and finally the *Hemicidaris Purbeckensis* of Forbes. The second group at the very top of the Jurassic formation, called in Franche-Comté 'Dolomies portlandiennes' of Marcou (*Etudes géologiques sur la Franche-Comté septentrional, Le système oolitique*, par Albert Girardot, p. 369, Paris, 1896), contains also a special fauna, indicating at some places a brackish formation, such as: *Corbula*, *Anisocardia*, *Cyrena*, *Protocardia*, *Lucina*, *Corbicella and Gervilliana*. However, at Gray (Haute Saône) the fauna is entirely marine, and Prof. Etallon, who has given a detailed description of that portion of Franche-Comté, has called it 'Diceras Portlandian beds.' In both divisions, or groups, corals are common round Gray, Morteau, Pontarlier and Salins. The thickness of the two groups varies between 150 and 600 feet, according to the more or less denudation of the upper portion of the strata.

Prof. Albert Oppel, of Munich, had created, in 1865, his Tithonic, or Tithonian formation (*Die Tithonische Etage*, Zeitschr. deutschen geologischen Gesellschaft, Jahrg, 1865, pp. 535–558, Berlin) to designate a special form of the divisions of the upper Jura, such as the Purbeck strata, the Solenhofer Schiefer and the Portland kalk, of the Alpine area and of the Mediterranean basin; it was a happy name, meaning that the groups of beds containing paleontological precursor forms of the Cretaceous fauna can be considered as a forerunner formation, announcing the arrival of another great system. Many papers have been published since the premature death of Oppel, in November, 1865, on that important question, the most remarkable being by Colonel A. Toucas, entitled '*Etude de la faune des couches tithoniques de l' Ardèche*' (Bull. Soc. Géol. France, 3d series, Vol. XVIII., pp. 560–629, Paris, 1890), in which he showed the existence of three different faunas, called Lower Tithonic or Diphyakalk, Middle Tithonic or Ardescian, and Upper Tithonic or Berriasian-Puberkian.

In England nothing can be correlated with those six hundred feet of limestone deposited in the Jurassic sea of southeastern France, of the Swiss Alps, of the Tyrol, of Stramberg (Carpathes), of Andalusia (Spain), but the brackish and fresh-water deposits of the Wealden formation. At Speeton there is nothing like it. The Portland stone is lacking there, very likely destroyed by denudation, and the series of Speeton clay is decidedly Neocomian, as it has been amply proved by Messrs. Judd, Lamplugh and Pavlow. If we consult the geological map of England, we see that directly over the small Portland beds, only eight or ten feet thick, we have brackish and fresh-water deposits, at first containing a few marine beds with the *Hemicidaris Purbeckensis* of Forbes, then becoming exclusively fluviatile, extending southward of Dorsetshire and the Isle of Wight, turning northward in the English Channel, reaching again the *terra firma* at Hastings and its environs, covering in the form of a cut ellipse all the country of the Weald, between the North Downs and South Downs (Kent and Sussex counties). We have there a sort of gigantic fossil mound, the remnant of a great delta or estuary deposit, like those actually going on at the mouth of the Ganges or of the Amazon. Farther west than the Weald region that formation lies directly over the Portland stone in the vale of Wardour, and very likely it extended northward. At the end of the Jura epoch the dislocation which has emerged the Jura formation in England and on the continent of Europe put a stop to those fresh-water deposits, and, being emerged as dry land, denudation began to remove easily such loose materials as clay and sands, leaving only the large semi-elliptical patches of southeastern England. The denudation lasted as long as the Neocomian or Lower Cretaceous deposits were going on at Speeton and in France and Switzerland; then by a general subsidence, affecting the whole coast of eastern England, the sea of the Yorkshire coast invaded the whole country south, depositing on the beds of the Wealden formation, and in some parts over the beds of the Portland stone and Kimmeridge clay, the strata called Lower Green Sand, Gault, Upper Green Sand and Chalk. The proof that the green sand sea came after the denudation, and even complete removal in some places of the Wealden, is shown by the existence of Lower Green Sand west of Hastings, lying directly on the

Hastings sand, when generally it lay always on the Weald clay.

The change effected on land and sea areas at the end of the Jura period was on a very grand scale in Europe as well as in America; and the Neocomian or Lower Cretaceous was not deposited in many portions of central Europe, especially in England, except at the little corner of Speeton, on the Yorkshire coast; and in the United States the Neocomian, even more limited than in Europe, was confined to Texas, the Indian Territory and southern Kansas.

One word of explanation on the use in France and Switzerland of the name 'Puberckian,' to designate the upper Tithonic or Berriasian. From the beginning, in 1848 and 1859, I showed that the name was wrongly applied to strata much younger than the Purbeck beds of England. The position of the *Hemicidaris Purbeckensis*, found in the first beds of the Salins limestone, authorize the correlation of the Puberckian of England with the base of the calcaires porlandiens or Lower Tithonic of the Jura. And the Purbeckian of the Jura Mountains, so well described by Gustave Maillard in his well known monograph (*Mém. Soc. Paléont. Suisse*, Vol. XI., Genéve, 1884), correspond and is the equivalent of the lower portion of the Spilsby sandstone of Lamplugh and Pavlow; it is to say, it represents in the Jura the base of the Speeton clay of England, instead of being correlated to the Purbeck beds of the Island of Portland.

CORRELATION OF THE ENGLISH AND EAST FRENCH FORMATIONS.

	England.	*Eastern France.*	
Speeton.	Tealby limestone.	Urgonian or Upper Neocomian.	Neocomian.
	Tealby clay.		
	Claxby ironstone.	Hauterivian or Middle Neocomian.	
	Spilsby sandstone.	Valengian or Lower Neocomian.	
	Weald clay.	Jura—Portlandian limestone.	
	Hastings sands.	Ardéche—Upper, Middle and	
	Purbeck beds.	Lower Tithonic.	
	Portland stone or *Exogyra virgula* zone.	Portlandian marls or *Exogyra virgula* zone.	

The correlation of the Wealden of England with the Tithonic of Franche-Comté, Switzerland, Savoy, Dauphiné, etc., is a beautiful work awaiting the careful researches of English geologists, and it is to be hoped that Mr. George William Lamplugh, now on the staff of the Geological Survey, who has done such good service at the geology of Speeton, will continue the work so well begun forty-eight years ago by Edward Forbes, so well traced in 1855 by John Phillips, and now so well advocated by Prof. O. C. Marsh.

Jules Marcou.

Cambridge, January 1, 1897.

COMPLIMENT OR PLAGIARISM.

The carefully prepared reply of Professors Beman and Smith (Science, p. 61) is disingenuous. Professor Halsted would gladly have printed in parallel columns the whole of his section, *Partition of a Perigon* (Elements, 151), which reappears in Beman and Smith, p. 179, as 'Partition of *the* Perigon.' As I made this section myself, I feel safe in asserting that it never before occurred in any geometry in the English language; but how could I ask the editor of Science to reprint it simply because Professors Beman and Smith had reprinted it? They deliberately say, "the *order* of the problems: To bisect a perigon, to trisect a perigon, to cut a perigon into five equal parts, to cut a perigon into fifteen equal parts," etc., "may be found in Newcomb's Geometry." (Science, p. 61.)

With Newcomb's book now in my hand, I assert that not one of these problems occurs therein. Next they assert that the word 'perigon' is 'found in several geometries.' If, in English, they mean Halsted's Metrical Geometry, 1881; Halsted's Elements, 1885; Halsted's Elementary Synthetic, 1892; Beman and Smith, 1895. The statement is disingenuous. If they knew of any other they would have named it.

George Bruce Halsted.

THE METEOROLOGICAL CONFERENCE AT PARIS. A CORRECTION.

On page 17 the last sentence of the first paragraph of my report should read as follows: "No one came from either Spain or Brazil, as was not the case at Munich, but Italy, Belgium, Canada and Mexico each sent a delegate to Paris, the two latter countries participating for the first time in an international meeting."

I desired to state briefly the principal countries which were represented at Munich and not at Paris, and *vice versâ*, but I might add that, although representatives from both Austria and Russia came to Paris, yet there was much regret at the absence of Prof. Hann, the eminent director of the Austrian Meteorological Bureau, and of Prof. Wild, late director of the Physical Central Observatory at St. Petersburg, both of whom had taken an active part in these international meetings since the first conference at Leipzig in 1872.

A. LAWRENCE ROTCH.

BLUE HILL METEOROLOGICAL OBSERVATORY, January 6, 1897.

THE STUDY OF FEAR.

EDITOR OF SCIENCE: One sentence in your account of Prof. Stanley Hall's study of fear has especially attracted my attention: "The fear of high places, President Hall thinks, is a vestigial trace, like the gill slits under the skin of our necks, antedating limbs and inherited from our swimming ancestors." A study of fear by the comparative and genetic method seems called for if results are to rest on a sure and broad foundation. In my own investigations on the psychic development of animals the subject has not been overlooked. I have called attention to a peculiar manifestation when even the youngest mammals and birds are placed near the edge of a surface that is elevated; but I have also pointed out that a turtle will walk off any such elevated support again and again, and, as is well known, a frog will jump almost anywhere, so that, if I understand Dr. Hall aright in the above sentence, these facts seem to present a difficulty in the acceptance of this part of his theory.

WESLEY MILLS.

MCGILL UNIVERSITY, MONTREAL.

GLOSSOPHAGA TRUEI.

TO THE EDITOR OF SCIENCE: In the Proc. U. S. National Museum, Vol. XVII., No. 1100, I described a new species of bat under the name *Glossophaga villosa*. But a *Glossophaga villosa* was described by Rengger (Naturgesch. der Säugeth. von Paraguay 1830, 80). I, therefore, rename the new species. I propose the following: *Glossophaga truei*, after Mr. Frederick W. True, the accomplished curator of Mammals at the Museum.

HARRISON ALLEN.

PHILADELPHIA, PA., January 13, 1897.

SCIENTIFIC LITERATURE.

Étude de Huit Essais de Machine à Vapeur. Par V. DWELSHAUVERS-DERY. Extrait de la Revue Universelle des Mines, t. xxxvi., 1896.

Mon. Dwelshauvers-Dery has published recently a report on the work of his laboratory, on his experimental engine, relative to the efficiency of the machine under various conditions, mainly affecting the quality of steam supplied.* He supplements that report, in the article here referred to, by a more complete study of these effects, and with extended illustration of his methods of conducting the work and of giving instruction in this department. He describes the conduct and computation of eight engine-trials, four with saturated and four with superheated steam. His conclusions from the preliminary study have already been given.†

Dwelshauvers is a consistent follower of Hirn, whose 'practical' or applied theory of the steam-engine he has developed, giving it algebraic expression and establishing seven principal equations by means of which he is enabled to compute essential data from the results of observation during an engine-trial. These expressions and their derivation are given in the report here under review. His graphical illustrations of the method of distribution and of variation of thermal and of dynamic energies in the cycle studied, and their interconversion, afford a means of bringing clearly before the investigator and the student the essential facts of engine-operation, in each case, and throw into high relief the most important phenomena.

They show clearly how great is the quantity of heat-energy exchanged between steam and cylinder-wall, and bring out plainly the fact that this waste is enormously less with superheated than with saturated steam. They show that the use of the steam-jacket is 'but a palliative, not a radical and complete remedy' for this waste. The steam-jacket, while almost invariably reducing wastes, nevertheless itself

* *Revue Universelle des Mines*, t. xxxiv., 1896.

† SCIENCE, N. S., Vol. IV., No. 89, p. 654.

wastes a large part of the heat which it transmits to the working charge; transmitting it through the cylinder-wall too late in the stroke to be of much service, or even so late as to be absolutely lost by passage into the cylinder during the period of exhaust, instead of, as necessary for best results, early in the induction period. Both in using the steam-jacket and in superheating, the reduction of the waste by initial condensation fails to give commensurate gain in work performed by the unit weight of steam. In one instance, for example, a reduction of initial condensation by ten per cent. only gave increase of work to the extent of two and a-half per cent. In another instance a reduction of wastes by twelve per cent. gave a gain of work of only three per cent. The action of superheated steam is more favorable, and the gain in work done and increased efficiency amounts to more nearly one-half the percentage of reduction of wastes by initial condensation.

The steam was condensed in a surface-condenser. The mean quantity of steam condensed per hour and per square meter was 13 kgs. The mean quantity of heat abstracted per kg. of steam was 567.7 calories. The mean quantity of heat traversing the condensing surfaces was 7,402 calories per hour and per square meter. The cylinder-heads transmitted nearly twice this quantity from their jackets into the cylinder, and the cylindrical jacket of the cylinder proper about one-fifth as much as the transmission into the condenser.

'Cylinder condensation,' during the brief period of its action on this engine, occurred at the enormous rate of 494,600 calories per hour hour and per square meter—seventy times as rapidly as in the surface condenser—and illustrates the most rapid transfer of heat known to the engineer or the man of science. Mon. Dwelshauvers is probably the first to measure this figure with any degree of accuracy, though Cotteril, long ago, gave us the general facts and approximate computations.

A very important and, to the experimenter, an unexpected, development was, as stated by him, the following: "With steam superheated to 166° C. at its entrance into the engine, and with saturated steam at 155° C. stagnant in the jackets, the use of the jacket gave an economy of 20 per cent. and over by reducing the initial condensation."*

The fact is now incontestable and it is easily seen that, so long as the action of the superheated steam is not such as to completely extinguish initial condensation by bringing the temperature of the cylinder wall fully up to that of the saturated boiler steam, the jacket may still find opportunity to reinforce the action of the superheated steam by doing some work in the interval between the instant of closing of the induction valve and that of its reopening in the succeeding cycle.

These contributions to our knowledge of the interior workings of heat and steam in the engine will undoubtedly be received as among the most important yet placed on record in the history of the experimental investigation of the steam-engine, and M. Dwelshauvers-Dery, through these researches, as an earnest and worthy disciple and successor to Hirn, will earn an enviable distinction. R. H. Thurston.

Cornell University.

Prehistoric Man and Beast. By Rev. H. N. Hutchinson, B. A., etc. Illustrated. D. Appleton & Co. 1897. pp. 298.

Mr. Hutchinson, already known to the readers of general literature by his works, 'Extinct Monsters,' etc., has endeavored, in the present volume, to present, in equally popular style, some of the latest results of geology and archaeology with regard to primitive man.

He distinctly disclaims writing for special students in either of these branches, and also offers himself solely as an interpreter of the opinions of others, and 'not as a Brahmin.' Nevertheless, he espouses very warmly, and claims as quite decided, various opinions which the 'specialist,' if he is fair-minded, considers still undetermined. For example, he heads one chapter 'The Myth of the Great Ice Sheet,' and assumes as incontrovertible Sir Henry Howorth's contention that the ice sheet of glacial

*This fact was asserted by the writer some years ago and was challenged by various authorities, including M. Dwelshauvers, who has since given us these facts and has frankly reversed his position. *Vide* Manual of the Steam Engine (R. H. T.), Vol. I.; Secs. 145, 153, pp. 598, 697; and Trans. A. S. M. E., Nov., 1889; Journal Franklin Inst., Dec., 1889.

times did not exist; which is very far from securing unanimous consent among geologists.

In the same manner Mr. Hutchinson knows a great deal more about the antiquity of man than most geologists. He knows that the human species is at the most not more than 25,000 years old. Surely he has with him in that calculation the decided minority of scientific students. To most, such a period seems quite inadequate to account for known facts in human history, apart from geologic questions.

His book has ten quite pretty full-page fanciful illustrations, designed by Cecil Alden, of the *Illustrated London News*. They represent a courtship of a warrior of the bronze age, the building of Stonehenge by the dwarfs, etc. The dozen chapters into which his subject is divided take up the cave-dwellers and reindeer hunters of the stone age, the 'myth' of the great ice sheet, changes of climate, the antiquity of man, the men of the bronze age, the dwarfs and the stone monuments, as dolmens, etc.

In the line of popularizing science these chapters are moderately meritorious. The leading English works have been consulted, and especial respect is paid to such as do not oppose received and conventional opinions, or do so the least. Their writers are preferred by the author as the correct exponents of modern research. He makes considerable business out the seeming contradictions of testimony and the disagreements of specialists, when the facts do not suit him (*e. g.*, the Spy Man and the Pithecanthropus). His reports, therefore, while apparently judicial in tone, are not really so in spirit. They are probably tinged by his avocation, as is almost inevitably the case.

D. G. BRINTON.
UNIVERSITY OF PENNSYLVANIA.

Chemistry for Beginners. By EDWARD HART, Ph.D. Third Edition. Revised and greatly enlarged. With 62 Illustrations and 2 plates. Easton, Pa., Chemical Publishing Company. 1896. Small square 8vo. 245 pages. Price, $1.50.

In text-books of elementary chemistry we have one of the most prolific fields of scientific literature, and, so far from deprecating this fact, each new book is to be welcomed as a contribution toward the solution of the difficult problem how best to teach chemistry to beginners. This problem is as yet far from solution; still, comparing the text-books of to-day with those of twenty, or even ten years back, it is apparent that a distinct advance has been made. This at least may be considered settled, that a prominent place must be given to experimentation on the part of the student. What shall be the relative order of theory and description and the order of the elements in descriptive chemistry is as far as ever from a final word, nor will the latter point, in the opinion of the writer, be settled until a natural order dependent on the periodic system is reached. As regards the former point, it must be kept in mind that there are two classes of beginners—those studying in secondary schools and those of maturer minds in colleges; a method of treatment suitable for one would quite possibly not be best suited for the other.

The book before us is from the pen of an experienced teacher, and of this it gives abundant internal evidence, and while written for beginners in colleges is equally well suited for use in high schools and academies. Ostensibly a third edition, it is so completely revised and so much enlarged that it is virtually a new book. The order of treatment is as follows: Introduction on 'rusting' of metals, oxygen, hydrogen, water (with potability, purification, etc.), constitution of matter, atmosphere, compounds of nitrogen, carbon and its compounds, halogens, sulfur, silicon, boron, phosphorus, arsenic, the metals, the carbon compounds (sixty-six pages on organic chemistry).

The theoretical portion of the subject is taken up from time to time, under appropriate compounds or elements. While the elements are considered, for the most part in the usual groups, little or no regard is paid to the periodic law in their arrangement. Equations for reactions are very sparingly used, and the word valence seems not to occur at all, although graphic formulæ are used, especially in the portion on organic chemistry.

The strong feature of the book is in experimentation. Over two hundred experiments are described, and it would be difficult to find a book containing as many pertinent, well selected,

clearly described experiments, so well fitted to elucidate the text. Even experienced teachers can gain many useful points from this book. The introduction of quantitative experiments near the beginning is a great advantage, and one could wish that Prof. Hart had increased their number, were it not for the great practical difficulty of supervising a large class of novices in quantitative manipulation.

To another feature of the book attention is called in the opening paragraph of the preface: "In compiling the following pages I have tried to bear constantly in mind the fact that a large majority of those studying chemistry are not likely to become professional chemists, and have therefore taken pains to enlarge upon those topics which all educated persons should understand, such as water purification, fertilizers, the concentration of ores, the roasting of ores, assaying, the iron blast furnace, steel manufacture, etc." In these descriptions as well as in most other cases the book is up to date, and is remarkably free from portrayals of antiquated processes handed down from author to author, and so often found in modern text-books.

The book offers occasional opportunity for criticism. NO is so universally called nitric oxid or nitrogen monoxid that it is confusing to name it nitrogen dioxid; one can hardly say that 'chloric acid is *contained in* chlorates;' but points of this kind are few.

The book is attractively gotten up and the proof has been very carefully read. It should find entrance into many laboratories outside of that of its author.

Jas. Lewis Howe.
Washington and Lee University.

Die Chemie im täglichen Leben. Gemeinverständlichen Vorträge von Dr. Lassar-Cohn, Universitäts professor zu Königsberg in Preussen. Verlag von Leopold Voss, Hamburg und Leipzig. 1896.

This book consists of twelve popular lectures on chemistry delivered by the author before the 'Verein für fortbildende Vorträge' in Königsberg. The lectures cover a wide range of topics of interest to a popular audience and are presented in a very clear and forcible manner. Among the many subjects considered may be mentioned breathing, the weight and analysis of the air, the barometer, argon and ozone, combustion, matches, yellow and red phosphorus, the nature of flame, candles, oils and petroleum, the elements, chemical formulas, atoms and molecules, distillation, petroleum ether, paraffin and vaseline, the manufacture of illuminating gas and its by-products, the incandescent gas-burner and cooking with gas; artificial fertilizers, bones, superphosphates, potassium salts, acids, bases and salts, food-stuffs, digestion and fermentation, albumen, fats and carbohydrates, alcoholic beverages, vinegar, milk, cheese and butter, gunpowder, gun cotton, dynamite, collodion, wool, cotton and silk; leather and tanning, bleaching and dyeing, ink and paper; the manufacture of soda, potash, sulphuric acid, bleaching powder, soap, caustic soda and potash, glass and porcelain; photography in its various forms including color-photography, the metallurgy of some of the most important metals, alloys, alkaloids, chloral, ether, chloroform, antiseptics, iodoform, carbolic acid, salicylic acid, etc.

The book is illustrated with some fourteen wood-cuts, which add much to the interest in the reading matter and serve to explain much that otherwise might not be so clear to the reader.

The most recent views on the subjects considered are given, and the book is up to date in every particular, and yet the language is so simple and the explanations so clear that any person of average intelligence can readily understand them.

The book is extremely interesting and instructive and will fully repay careful reading. Even the experienced chemist will find here much information not found in the ordinary text-books.

The publication of such a series of popular lectures, which all can understand, must have a very beneficial influence on the study of chemistry and will show the uninitiated, as nothing else can, what the chemist has done and is doing. An English translation of the book by M. M. Pattison-Muir, published by J. B. Lippincott & Co., has recently appeared.

W. R. O.

SCIENTIFIC JOURNALS.

AMERICAN CHEMICAL JOURNAL, JANUARY.

On Parabromdimetanitrotoluol and some of its derivatives: By C. L. JACKSON and M. H. ITTNER. This work was undertaken to study the behavior of a bromine atom, in the ortho position to two nitro groups, but not exposed to a third negative group in the para position. The substances studied were the benzene and toluene bromdinitro compounds. The toluene compound was found to be poorly suited for the research on account of its stability. Several of its derivatives were made and studied; but in some cases the methyl group seemed to exert a protective action, preventing the formation of compounds whose analogues in the benzene series were easily formed. The bromdinitrobenzoic acid was found to be more reactive than the toluic acid. A number of related acids and their salts were made, and attempts were made to greatly increase the complexity of the molecules; but it was found that the substances lost their tendency to crystallize as the complexity increased, and pure substances could not be obtained.

Aluminum Ethylate: By N. H. HILLYER and O. E. CROOKER. In preparing amalgamated aluminum for reduction in neutral solution the authors found that contact with the air was injurious, and they therefore attempted to prepare it in alcohol without allowing it to come in contact with the air. To their surprise, and contrary to the statements of others who had worked on these substances, quite a reaction took place between the amalgamated aluminum and absolute alcohol, the final product being a white solid. This product was distilled, and a mixture of aluminum ethylate and aluminum chloride was obtained.

On the conditions affecting the Volumetric Determination of Starch by means of a solution of Iodine: By F. T. LITTLETON. The author has studied the accuracy of volumetric determinations depending upon the starch iodide reaction. She found that not only was the reaction affected by the temperature, but that starch from different sources gave different results. She reached the same conclusion that has been reached by others, namely, that the so-called iodide of starch is probably not a definite chemical compound and that it is very easily dissociated.

Silver Hydride: By E. J. BARTLETT and W. F. RICE. The authors succeeded in preparing silver hydride by precipitating a dilute solution of silver nitrate with dilute hypophosphorus acid. The product is filtered off rapidly and washed. It forms black spongy flakes and is not decomposed by water.

On the Volatility of Ferric Chloride: By H. P. TALBOT. Conflicting reports are found as to the volatility of ferric chloride, and the author undertook this investigation to determine the accuracy of these statements. He found that ferric chloride is not volatilized by boiling its solutions, and that no loss ensues on heating the dried residue to 130°. In the presence of aqua regia or when overheated with ammonium chloride there is, however, a slight loss.

Concerning properties belonging to the Alcohol-soluble Proteid of Wheat and of certain other Cereal Grains: By G. L. TELLER. The author found that the method of separation of the gluten and non-gluten compounds in wheat, by means of dilute salt solutions, was inaccurate, on account of the fact that the same nitrogen compounds were soluble both in the dilute salt solutions and in 75 per cent. alcohol. He separated the part precipitated by the salt solution, and then added a solution of phosphotungstic acid to the filtrate. By this process he separated the amides from the proteids soluble in salt solution. The part precipitated by the salt solution consisted of edestin and leucosin, and the sum of the nitrogen in these substances and that in the amides subtracted from the total nitrogen gives that in the alcohol-soluble proteid, which is gliadin.

Silicide of Chromium: By G. DE CHALMOT. This investigation shows that not only does chromium form a silicide of the formula $SiCr_2$, the compound obtained by Moissan; but also a compound Si_2Cr, formed by heating chromium sesquioxide, charcoal and silica in an electric arc furnace.

Paraisobutylphenoxyacetic Acid: By W. P. BRADLEY and F. KNIFFEN. This acid was prepared by the same methods used in the formation of its homologue phenoxyacetic acid. A number of its salts were prepared and studied.

On a simple automatic Sprengel Pump: By B. B. Boltwood. The author describes a form of pump which can be easily made and which he recommends as very satisfactory.

The following books are reviewed in this number of the *Journal:* The Practical Methods of Organic Chemistry, L. Gattemann (translated by W. B. Shober); Notes on Qualitative Analysis, W. P. Mason; Chemistry for Beginners, E. Hart; Manual of Determinative Mineralogy, Geo. J. Brush; Chemistry in Daily Life, Dr. Lassar-Cohn; Handbook for the Bio-Chemical Laboratory, J. A. Mandel.

J. Elliott Gilpin.

SOCIETIES AND ACADEMIES.

NEBRASKA ACADEMY OF SCIENCES, DECEMBER 30, 1896.

The seventh annual meeting of the Nebraska Academy of Sciences was held December 29th at Lincoln and the following papers were presented:

Annual address of the retiring President, Prof. E. H. Barbour, on the 'Economic and Educational Value of Academies;' a comparison of the methods of various academies, with recommendations for the betterment of our own.

'A new Plankton Pump,' Prof. H. B. Ward and Prof. Chas. Fordyce, a device for collecting aquatic organisms by pumping from any desired depth; followed by remarks by Prof. Ward on the importance of continued biological observations.

'Report of Progress in the Study of the Fauna of the State,' Prof. L. Bruner, showing how few species have been reported from Nebraska in most groups, although our number of species is undoubtedly very large.

'Some Methods of Collecting, Preserving and Studying Fossils,' Miss Carrie Barbour, illustrating the fact that forms apparently hopelessly disintegrated may be collected and preserved.

'Nomenclature of Nebraska Forest Trees,' Dr. Chas. E. Bessey, giving the history of changes in names of our trees with the names now adopted.

'Reflections on the Genus *Ribes*,' Prof. F. W. Card, urging the validity of species developed by cultivation as well as those found wild whose genealogy is not known.

'Chalcedony-lime Nuts of the Genus *Hickora* from the Bad Lands of Nebraska,' Prof. E. H. Barbour.

'Comparison of Nebraska Diatomaceous Earth from Nebraska and adjacent States,' C. J. Elmore.

'What is Mathematics?' Dr. E. W. Davis, showing how mathematics is designed to co-ordinate other sciences.

'A Family of Quartic Surfaces,' the sum of the distances of whose locus from two given surfaces is constant, Prof. R. Moritz.

'A Form of Weir Notch,' the flow of water through which varies directly as the head instead of following the more complicated law of the ordinary notch, Prof. O. V. P. Stout.

'An Observation upon annual Rings in Tree Growth,' Prof. F. W. Card, in which complete defoliation did not cause the formation of a second annual ring.

'Internal Temperature of Trees,' R. A. Emerson. Temperatures as high as 110° reached at a depth of one-half inch below the bark of trunks exposed to the sunshine; daily fluctuations greater in dead limbs than in live ones.

Owing to the late hour the following papers were read by title only: 'Notice of two Important Books on Systematic Botany,' Chas. E. Bessey; 'The Barites of Eastern Nebraska and the Bad Lands,' Erwin H. Barbour; 'Some Data as to Wind distribution of Seeds,' Ed. M. Hussong; 'Parasites of Nebraska Dogs,' Henry B. Ward; 'Discovery of the first Meteorite in Nebraska,' Erwin H. Barbour; 'Notes on Phyllopod Crustacea,' H. A. Lafler and A. S. Pearse; 'The Study of Botany in the School for the Blind,' Dr. C. E. Bessey.

The following officers for the ensuing year were elected: President, Dr. A. S. von Mansfelde; Vice-President, Dr. E. H. Barbour; Secretary and Treasurer, Prof. G. D. Swezey; Custodian, Prof. Lawrence Bruner; Directors, Dr. H. B. Ward, Prof. H. B. Duncanson, Mr. C. J. Elmore and Dr. H. Hapeman.

The next annual meeting will be held on the day following Thanksgiving. The volume of proceedings for 1894–95 is just issued. Price, 50 cents.

G. D. Swezey,
Secretary.

BIOLOGICAL SOCIETY OF WASHINGTON. 269TH MEETING. SATURDAY, JANUARY 3.

MR. F. A. LUCAS exhibited the skull of a Sea Lion, *Eumetopias*, in which one ramus of the jaw had been broken when the animal was quite young. The fracture had not united and, in consequence, only one side of the jaw was functional, the result being that this side had developed more than the other, making the cranium asymmetrical.

Mr. E. W. Nelson spoke on 'New Birds from Mexico,' stating that he had quite recently collected forty-four new species and subspecies, including one new genus, from a comparatively limited area in Mexico and western Guatemala.

Mr. F. A. Lucas read a paper on the 'Natural Mortality among Fur Seals' giving the results of the observations made during the summer of 1896, by the Commissioners of the United States, Great Britain and Canada. It was stated that there was a considerable mortality among very young seals, due to their being trampled on by the adult seals in the harems. This great loss took place only on ground free from obstructions, where the quarrelsome bulls and startled cows could move readily about. Some small number of seals starved from natural causes, a few were drowned, and some died from accidents and diseases, such as inflammation of the bowels, inflammation of the kidneys, etc. The *known* causes of death among the adults were few, principally fighting among the bulls and consequent injury to the females, but it was evident that for some reason the mortality among cows was great.

F. A. LUCAS,
Secretary.

THE ACADEMY OF SCIENCE OF ST. LOUIS.

AT the meeting of the Academy of Science of St. Louis of January 4, 1897, Dr. Amand Ravold gave a microscopic demonstration of Widal's test for typhoid fever, demonstrating that after the disease has existed for four days or more the blood of typhoid patients, probably because of some contained anti-toxine, possesses the power of inhibiting the motion of typhoid bacilli from a pure culture introduced into it within a period of one hour or less, whereas in normal blood similar bacilli retain their power of locomotion for an indefinite length of time. It was stated that typhoid blood possesses this property even after having been dried for a period of four weeks or more, so that a few drops obtained from a person suspected of having the disease may be sent to suitable places for applying the test, thus rendering comparatively easy the early diagnosis of a disease which in its early stages presents many clinical difficulties.

Prof. F. E. Nipher gave preliminary results of partially completed experiments, made through the courtesy of the Burlington and Illinois Central Railroads, to determine the frictional effect of trains of cars on the air near them. His apparatus consists of a cup collector supported on a bar capable of sliding in guides on a clamp attached to the window sill of the car. The bar is thrust out to varying distances up to 30 inches. The mouth of the collector is turned in the direction of motion of the train. The pressure due to the motion is conveyed through a rubber tube attached to the rear of the collector and passing lengthwise through the bar to a water manometer. The manometer has a tube with a rise of 4 or 5 in 100 and is provided with a pivotal mounting and a level.

The pressure near the train is comparatively small and increases as the collector is thrust further out. It approaches a limit corresponding to the train velocity at the instant. Prof. Nipher finds the relation between the limiting pressure and velocity to agree exactly with the formula

$$P = \frac{\delta}{2} v^2$$

where v is the train velocity in centimeters per second, P is the pressure in dynes to the square centimeter, and δ is the density of air in C.G. units at the temperature and pressure of the observations. He finds the pressure a maximum when the axis of the collector is parallel to the direction of motion with the mouth to the wind. Turning the collector until its axis makes an angle of about 60° with this position, the pressure reduces to zero. At greater angles the pressure becomes less than atmospheric pressure by an amount which reaches a maximum at an angle of 90°, and passes through a

minimum at an angle of 180°, when the collector is in a trailing position. The sum of the coefficients for the two positions of maximum compression and minimum exhaust is almost exactly the same as Langley obtained with a pressure board when exposed normally to the wind.

The result shows that a large amount of air is dragged along with the train, the motion being communicated to air many feet away. This air is a source of danger to one standing too near the train when at full speed. One is likely to be toppled over, and the blow of the air communicates a motion of rotation which may cause one to roll under the train if the nature of the ground does not prevent such result. It was remarked, however, that where trains have a right to run at any speed no prudent person would stand so near to a train as is necessary in order to be in danger from this source.

The following officers were declared elected for the year 1897: President, M. L. Gray; First Vice-President, E. A. Engler; Second Vice-President, Charles R. Sanger; Recording Secretary, William Trelease; Corresponding Secretary, E. C. Runge; Treasurer, Enno Sander; Librarian, G. Hambach; Curators, Julius Hurter, J. H. Kinealy, E. Evers; Directors, M. H. Post, Joseph Grindon.

One person was elected to active membership.

William Trelease,
Recording Secretary.

NORTHWESTERN UNIVERSITY SCIENCE CLUB.

At the December meeting, Dr. Marcy in the chair, Prof. Crook presented 'Some Geological Causes of the Scenery of the Yellowstone National Park' as a report upon a trip to that region. The nature of the scenery is due: 1, to the fact that the country is geologically young, having begun to take its present form at the close of the Cretaceous; 2, to the fact that it is composed of volcanic materials which were erupted in this order, viz: Andesite, rhyolite, basalt; 3, to the fact that the rhyolite is not yet cooled; and 4, to the fact that the topography of the country causes precipitation of meteoric waters unusually great for that region and, consequently, low temperature and powerful erosion. The difference in chemical composition of the spring waters is accounted for on petrographical grounds.

Geyser action is satisfactorily explained in accordance with Bunsen's theory. The unique coloring in the region is due to biological and to mineralogical causes. Twenty hand specimens and thin sections and fifty lantern slide views illustrated points considered.

Evanston, Ill. A. R. Crook,
Secretary.

UNIVERSITY OF WISCONSIN SCIENCE CLUB, DECEMBER 16, 1896.

Prof. C. R. Van Hise, in his paper, 'The Deformation of Rocks,' discussed the subject in general. It was shown that, in order to adequately understand the phenomena of deformation, the position of rocks with reference to the surface must be considered. Observations in the field show that there are three somewhat distinct zones—an outer zone of fracture, a middle zone of combined fracture and folding, and a deeper seated zone of folding. However, whether folding or fracturing occurs depends largely upon the rapidity of deformation and upon the strength of the rock in question, as well as the superincumbent load. Therefore at the same depth may be found all the phenomena of the zones of fracture and flowage; but, broadly stated, the outer zone is particularly characterized by joints, faults and brecciation; the deep seated zone is particularly characterized by folding and cleavage; and the middle zone shows all of these phenomena with various complex relations.

Mr. L. S. Cheyney, in his paper, 'Résumé of Work done on the Flora of Wisconsin,' discussed briefly the history of systematic botanical investigation upon the vegetation of the territory now included in the limits of the State, from the journeys of the Jesuit missionaries to the present time.

Mr. C. H. Ford, in his paper, 'The Modern Telephone Transmitter,' gave an account of some original work done to test the comparative worth of modern transmitters.

Wm. S. Marshall,
Secretary.